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The Welsh Engineers' and Founders' Association

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New York Convention Papers—III

In previous editorials we have reviewed the contributions made to the American Foundrymen's Association New York Convention in so far as they related to ferrous materials. Numerically, the first Paper to be presented was by Mr. M. E. Brooks and Mr. A. W. Winston, covering magnesium foundry practice. Here are some of the points disclosed. Synthetic sands are gaining ground, preference being given to a washed silica base with an A.F.A. grain fineness from 65 to 100, milled with 3 to 4 per cent. bentonite and about the same amount of water. If 65 grain size—a very open sand—is used, there is a tendency for the resultant castings to have a rough surface, and to overcome this about 1 per cent. of ethylene glycol is mixed with the sand or the mould surfaces are reeked. For general use an 80 grain size sand is to be preferred. The latest inhibitor to be used is ammonium silicofluoride, which now replaces part of the sulphur and boric acid. The total amount of inhibitor used is of the order of 4 to 10 per cent., varying with the metal section thickness. Detailed specifications are given for core mixtures, baking, and pasting practice. It is suggested that the moulds should run at their lowest point through a filter—either a perforated skim gate or steel wool, situated preferably at the base of the down runners; for it is American practice to use a quantity of smaller ones rather than one large one. Before and during pouring the metal is dusted with a mixture made up of 80 per cent. sulphur, 17.5 per cent. boric acid and 2.5 per cent. of ammonium borofluoride. Altogether this is an extremely worthwhile Paper, exhibiting as it does the widest practical applicability.

The second Paper, on "The Effect of Furnace Atmospheres in Non-Ferrous Melting," by Mr. J. M. Kelly, is reminiscent and largely confirmatory of the work done in this country by Mr. Frank Hudson.

The P.M.G. series of alloys is the subject of a practical study by Mr. E. G. Jennings and Mr. Harold J. Roast, of the Canadian Bronze Company. Because this copper-silicon-iron alloy can quite usually replace the tin bronzes, it is an important economic factor in the American Defence programme. The authors have confined their remarks to the sphere of practical production methods. There is some condemnation of the 88:10.2 gun-metal as a material for pressure-tight castings in a Paper by Mr. Alfred H. Hesse, entitled "Some Causes of Porosity and Leakage in Non-Ferrous Castings." His first conclusion, drawn after an extensive research, is made with little reservation, and reads: "Tin causes intercrystalline shrinkage porosity in tin bronze. This obviously suggests a change in composition, or perhaps even a substitution of other alloying elements for tin." In tin bronzes, hydrogen and water vapour are confirmed as being causes of gas porosity; sulphur only slightly so, and CO, CO_2, O and N virtually without action. The replacement by 6 per cent. nickel of a corresponding amount of tin widens the pouring temperature range—a factor demanding control within narrow limits for the production of porosity-free castings—whilst at the same time yielding good physical properties.

There were three "general interest Papers." Prof. F. Holtby and Mr. H. F. Scobie have described the syllabus and the plant facilities for the training of graduates in foundry technology at the University of Minnesota. That success has met the efforts put forward is clearly demonstrated by the increased number of students taking the course each year. Mr. E. C. Bumke, in his Paper "Daily Expense Control and a Variable Foundry Budget," has explained a method covering these activities, which has been successfully operated by the Oliver Farm Equipment Company. It yields results superior to those reporting at weekly or monthly intervals. Using the rather trite caption "Co-operation of the Engineer, Patternmaker and Foundryman," Mr. E. J. Brady has followed the precept that an ounce of practice is worth a ton of theory, and instead of making the usual plea, has demonstrated by a dozen or more examples taken from actual practice how co-ordination of effort is easily enforcible by intelligent direction. We feel sure that British foundrymen will endorse our views that their American colleagues have been particularly fortunate in the subject matter of the Papers chosen for presentation to the recent New York Convention.

Grade 4 Cast Iron*

B.S.I. REQUIREMENTS

It is germane to the discussion on Mr. MacRae Smith's Paper, that readers should have knowledge of the provisions associated with Grade 4 as given as an inset to B.S.I. Specification No. 786—1938, the main clauses of which are set out below.

Early Co-operation

In using Grade 4 particular attention is drawn to the following paragraph which appears in the Foreword of B.S. 786:—"It is pointed out that high-duty cast iron is usually more expensive to produce than ordinary cast iron, particularly in the higher grades. Moreover, the production of castings in high-duty cast iron often involves special technique. It is recommended, therefore, that for large and/or intricate castings, or where the castings have to withstand exceptional conditions, the grade of iron selected and any heat-treatment involved should be agreed upon between the manufacturer and purchaser."

Requirements of Grade 4

Castings conforming to Grade 4 shall comply in all respects with the requirements laid down in Clauses 1 to 12 of the specification, and shall give the following mechanical properties:—

Dia. of test bar.	Minimum breaking load.	Corresponding transverse rupture stress.	Minimum deflection.	Minimum ultimate tensile stress.
In.	Lb.	Tons per sq. in.	In.	Tons per sq. in.
0.875	1,910	39	0.14	25
1.2	3,130	37	0.23	23
1.6	7,010	35	0.18	22
2.1	11,200	33	0.24	21

Heat-treatment other than stress relief annealing shall not be carried out without the prior consent of the purchaser.

0.6 in. Test Bar

Provision is made herewith for the use of a test bar 0.6 in. in dia. The details of the dimensions of the test bar, conditions of testing, and the x and k factors shall be as given in the appendix.

The mechanical properties to be obtained when the 0.6 in. test bar is used for the 4 grades of cast iron now provided for in B.S. 786 shall be as follows:—

Grade of iron.	Minimum breaking load.	Minimum transverse rupture stress.	Minimum deflection.	Minimum ultimate tensile stress.
	Lb.	Tons per sq. in.	In.	Tons per sq. in.
Grade 1	570	27	0.07	16
„ 2	635	30	0.08	19
„ 3	715	34	0.09	23
„ 4	865	41	0.10	26

Details of the 0.6-in. Test Bar.

Clause 6.—Dimensions of test bars

(a) *Transverse test bars*—		
Diameter of test bar	..	0.6 in.
Limits on diameter	..	±0.045 in.
Overall length	.. ..	10 in.
Main cross-sectional thickness of casting represented	.. .. ..	not exceeding $\frac{3}{8}$ in.
(b) *Tensile test bars*—		
Gauge diameter	.. D	0.399 in.
Area	.. .. A	0.125 sq. in.
Parallel length, min.	P	1 in.
Radius, min.	.. R	$1\frac{1}{4}$ in.
Length of plain ends, min.	 C	$1\frac{1}{4}$ in.
Screwed ends, size	.. E	$\frac{1}{4}$ B. S. P. $\frac{5}{16}$ B. S. F. $\frac{5}{16}$ B. S. W.
Screwed ends, length, min.	.. .. F	$\frac{9}{16}$ in.
Approximate overall length, min.		
plain ends	.. L_p	$4\frac{1}{2}$ in.
Screwed end	L_s	3 in.
Main cross-sectional thickness of casting represented	.. ..	not exceeding $\frac{3}{8}$ in.
Clause 8.—Transverse test.		Distance between supports 9 in.

APPENDIX.—*Transverse Rupture Stress (Modulus of Rupture).*

Table of factors x and k.†

0.6 in. Test bar.		
Diameter.	x	k
in.		
0.56	1.230	0.0582
0.57	1.166	0.0552
0.58	1.107	0.0524
0.59	1.052	0.0498
0.60	1.000	0.0474
0.61	0.952	0.0451
0.62	0.906	0.0429
0.63	0.864	0.0409
0.64	0.824	0.0390

† Factor x for converting actual breaking loads into equivalent breaking loads of bars of standard, and k for converting actual breaking loads into transverse rupture stress.

* Abstract by kind permission of the British Standards Institution from B.S. 786, "High-Duty Iron Castings," copies of which may be obtained from the Institution, 28, Victoria Street, London, S.W.1. (Price 2s. 3d., post free.)

I.B.F. Elects New Members

At a meeting of the Council of the Institute of British Foundrymen, held at the Midland Hotel, Manchester, on July 12, 1941, the following were elected to the various grades of membership.

Subscribing Firm Member

G. H. Langler & Company, Limited, 249, Main Street, Johannesburg, South Africa, electrical and mechanical engineers (representative, H. H. Jones).

Members

J. J. Ashton, foundry plant engineer, Ford Motor Company, Dagenham; Wm. Ballantyne, foundry manager, Stewarts and Lloyds, Coatbridge; T. C. Steven, steel founder, Springfield Steel Company, Limited, Glasgow; P. McGovern, foundry manager, Appleby & Company, Sheffield; R. T. Wood, metallurgist, Ford Motor Company; T. J. Parker, and G. Cherry Patterson.

Transfer from Associate Member to Member

A. Campbell Smith, works manager, Bristol Aeroplane Company, Limited.

Associate Members

K. S. Ayapa, mechanical engineer, J. Archdale & Company, Worcester; W. E. Browning, assistant superintendent (technical), Bristol Aeroplane Company, Filton; P. Geary, metallurgist, A. Kershaw, Leeds; A. E. Leng, foreman moulder, T. Firth & J. Brown, Darnell; H. Plucknett, plaster patternmaker, Bristol Aeroplane Company; H. W. Brown, patternmaker, East Rand Engineering Company, Limited; J. G. Burrows, patternmaker, Eagle Brass Foundry, Germiston; J. P. Dobbie, iron and steel moulder, Cruikshank & Company, Denny; A. C. Lester, moulder, Coldbath Foundry, London; Wm. McLelland, and A. McKenzie.

"Yield Strength" and "Yield Point"

A.S.T.M. Committee A-7 on Malleable-Iron Castings, in a progress report submitted at the recent Chicago meeting, recommends that in the Committee's specifications for malleable-iron castings the term "yield point," wherever it appears, be changed to read "yield strength," in order to bring the nomenclature in line with accepted practice, this change to be made in 1942, when the next Book of Standards is issued.

Random Shots

A dictionary is an interesting and informative piece of literature, and an infinite source of entertainment withal (always supposing the Bank Holiday to be too wet for gardening!). Only the other day the Editor wanted to know how to spell the nice short word meaning "a low strong truck upon four small wheels." Should it be bogey, or bogie? Even the dictionary could not make up its mind it seems, for it gave the alternative spelling *bogie, bogy* or *bogey*. How golfers spell their meaning of the word was the next obvious thought. Good! they spell it *bogey*; but (in parenthesis) it can also be spelt *bogy* or even *bogie*; then there is the familiar devil of one's childish fears. Is he a *bogy*, then? Sure enough he is a bogy, but he may also be a *bogey* or a *bogie*. What a bogy (bogey or bogie) is the English language!

* * *

The letter "B" for bogey or for bentonite naturally leads to the letter "C," and it amused "Marksman" to see what the Oxford professors have to say about the word "cast"; a word perhaps second in common usage in any foundry (the commonest words not being polite parlance). So far from being the special "perks" of the foundry industry, it is used in a dozen or more different spheres of activity. A clerk makes a cast of his accounts. An angler makes a cast of his fishing line. A wrestler makes a cast of his opponent. The stage manager chooses the cast for his play. The huntsman forms a cast of the hounds when he sends them in search of a lost scent. The humble earthworm makes a cast. The coremaker may have a cast in the eye, and may show the apprentices how to make a cast of the dice in the lunch hour; but all of these fade into insignificance when compared with the expression that the blonde trainee casts at any good-looking stuff in the workshop.

* * *

Bus conductorettes have caused a flutter in the managerial dovecote by wearing no stockings and rolling up their sleeves. They have, however, won the battle, and can now do what they like (within reason) with their uniform. It is reported that they based their argument on a claim for equality with their mates at the wheel, and should be allowed to change gear just as freely as they do!

* * *

From America comes this good story.

Proud Mother: "I'm ever so pleased with our 'Arry. They've promoted him for being rude to the sergeant. They've made him into a courtmartial."

* * *

"Sorry I can't come with you," a youngster was heard to remark to a little friend the other day. "I'm not allowed to cross the main road except in convoy."

* * *

The oft-repeated item of news that the R.A.F. have once again bombed Cologne only supports the claim of the history books that Britishers make good colognisers.

"MARKSMAN."

Book Review

Handbook of Workshop Calculations. Published by H.M. Stationery Office, York House, Kingsway, London, W.C.2. Price 3d. net.

Never has an arithmetic book been better set out than this new publication. Though it may be an adverse commentary on the educational system, on which so much money has been lavished, yet it is realised that such a revision is necessary in many cases. Actually, most children of twelve should be able to do every problem that is covered. Arithmetic is difficult to teach, and Dr. Chapman has done his work extremely well.

Mould and Core Washes*

Their Preparation and Possible Methods of Testing

By Wm. Y. BUCHANAN

The materials used in manufacture of blacking have been listed at great length elsewhere, including many forms of carbon more or less rare, and, for that reason expensive, but usually the base material is coke breeze and possibly some additions of fireclay.

Where fireclay is added, it is usually the custom, especially when subsequently mixed by hand, to make no further additions except water in the making of blackwash. The author has for a number of years used blacking made from coke only and added to the resultant blackwash such materials as bentonite, Colbond, dexterine, semi-solid core oil, coal dust of high volatile content, and even crude oil. The object of the bentonite, Colbond, dexterine and core oil was to prevent the blacking rubbing away readily after drying, although the core oil acts in a manner different from the clays. The coal dust was used with the same object in view, it being intended that at the drying temperature the volatile matter would be driven off and during the process a slight coking or crusting would take place.

Special additions such as alkalis, intended to improve the suspension of the clays in water, were not used owing to their corrosive action on the mixing tank, but crude oil was tried because of its action on coke dust, as in the Froth flotation process. The application of this crude oil is only possible when an emulsifier is used in the mixing process such as is described later in the Paper.

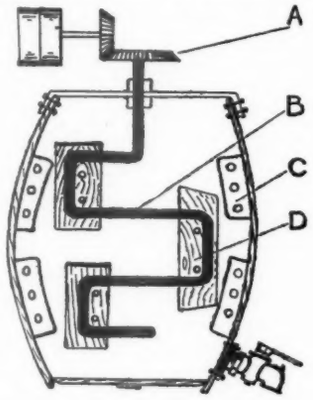


FIG. 1.—BARREL MIXER. A, DRIVING GEAR; B, STIRRER; C, BAFFLES; D, PADDLES.

Coke has a specific gravity of about 1.3., *i.e.*, very near to that of water, is by nature very hard and abrasive towards metals even when finely ground, has a low percentage of volatile matter, high fixed carbon, and usually low ash. Blackwash consists essentially of blacking and water plus additions, varying in concentration from a thin liquid to, in some cases, a heavy mud.

Method of Mixing

Coke dust itself tends to settle in water and constant stirring becomes necessary during use. Up till recently, the usual method which has been practised without variation for generations consists of a rectangular tank or trough in which the blackwash is mixed and stirred by pushing backwards and forwards a wooden rake with a long handle and probably some holes in the blade. The dry materials are slowly added and stirred in. The moulder always stirs the liquid before removing a bucketful for his own immediate use. By this means the liquid is always drawn from the top and has a tendency to concentrate as the level drops. It is, or was, the usual practice to mix this blackwash in considerable secrecy using various personal tests, such as dipping the hand into the blackwash and observing this as it dried with "the air of a chef." Many additions were made, of course, such as clay water made from common red clay, and the preparation of the blackwash might occupy a man's time equivalent to about 8 hrs. per week for a foundry employing 60 coremakers and moulders on dry sand and using two mixed lots of about 50 galls. each.

Mechanical Mixing

The author's experience of this problem covers a number of years, and details of methods actually tried out are included in the following notes. The first type (shown in Fig. 1) consisted of a barrel and stirrer. Where an overhead shafting is available for power drive, a barrel or circular tank is fitted with a simple type of stirrer and suitable gearing, and preferably a fast and loose pulley. Baffles are fitted to the sides of the vessel to assist mixing and prevent the liquid from swirling round bodily, as it thus tends to climb rather high at the outside. A draw-off cock is provided at the bottom of the barrel or tank.

This type of apparatus, which is essentially a stirrer, presents some difficulty in first obtaining a solution, as the partly-moistened materials tend to build up heavily on the baffles. With constant scraping down, the liquid becomes smooth and uniform, and, so long as the movement continues, tends to remain so, but if allowed to settle overnight or week-end, the mass becomes solid in the bottom and extremely difficult to start up.

Since the liquid is in this case drawn off from the bottom, and since the heavier liquid comes off first, the blackwash becomes thinner as the level falls. The upkeep on this barrel is not excessive, being mainly due to corrosion wear, and perhaps the neglect of lubrication of the gearing and bearings which readily become contaminated with blacking dust.

Wet Grinder Type of Mixer

The machine shown in Fig. 2 first appeared in foundry advertisements about 1933 or 1934, and was put on the market by the British Rema Company, Limited. It consisted of one or two tanks and a system of piping and valves for drawing liquid from the bottom of the tank or tanks and passing this through a wet grinder unit, then delivering it to the top of the tank. The machine was belt or motor driven. It appeared to be very suitable for materials in which a mixing and grinding action was required. The claims made for it were that it produced 40 galls. of high grade blacking or other facing material in 15 mins., and there can be little doubt that this output would be achieved. The machine was advertised as being in several sizes, but the author has no experience in the operation of these machines.

FIG. 2.—MIXING MACHINE DESIGNED BY BRITISH REMA MANUFACTURING COMPANY, LIMITED.

Emulsifier Type of Mixer

With the wet grinder type of mixer in mind the author had a plant constructed on a similar system, replacing the wet grinder unit with a centrifugal pump of the "chokeless" type, *i.e.*, one constructed to pump liquids in which an occasional solid piece of overall size up to 2 in. entered the pump and subsequently went through the system. The reason for having this machine constructed was that the materials used were ground and graded and therefore did not require further grinding.

The early trials of this machine fully justified the expectations, so much so that the makers manufactured a number of machines for other foundries, and an illustration of one of these machines appears in a Paper by Mr. Hudson and illustrated diagrammatically in Fig. 3. The time for filling the tank, adding the dry materials, and mixing completely was 19 mins.

* Presented at the 38th Annual Conference of the Institute of British Foundrymen, held at Manchester on July 12.

Mould and Core Washes

for 50 galls. of water, plus other materials, making in all about 60 galls. of blackwash. The action of this system seems ideal, and by keeping the delivery tube close to the side of the tank and fitting a right angle bend the stream of liquid round the side of the tank set up a rapid whirlpool effect with a large vortex in the centre. The advantage of this right angle bend which was a later addition to the machine and the resultant whirlpool was that dry materials which normally float and do not wet quickly on a quiet surface in this case swirled round once or twice and then shot down the vortex, when it was immediately dispersed in the pump.

For a considerable time no mechanical trouble was encountered, and the usual practice was to mix the blackwash in the tank nearest the pump and deliver to the outer tank for storage and use; a new lot being always ready to follow the one nearly finished. Where blackwash had been unintentionally allowed to settle in the pump or occasionally due to severe frost and lack of shop heating during winter holidays, great difficulty was of course encountered in starting up.

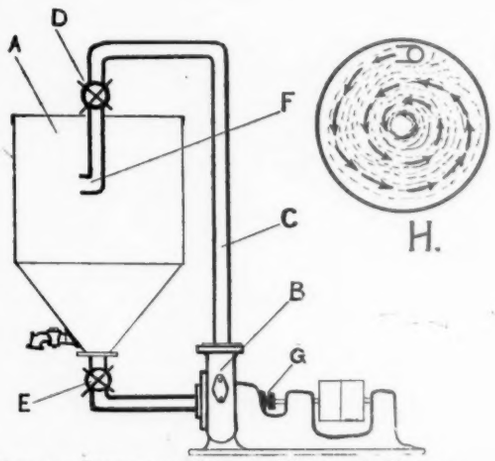


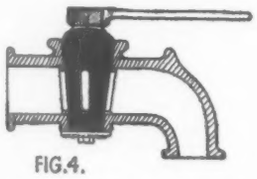
FIG. 3.—EMULSIFIER TYPE OF MIXER. A, 70-GALL. TANK; B, 2-IN. CHOKELESS PUMP; C, 2-IN. TUBE FOR CIRCULATION; D AND E, SHUT-OFF VALVES; F, RIGHT-ANGLE BEND; G, PACKING GLAND; AND H, WHIRLPOOL ACTION DURING MIXING.

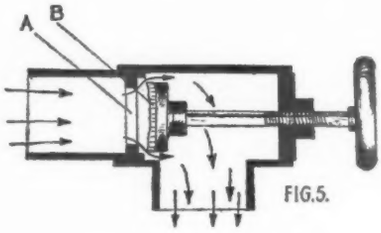
It was usual to put the machine on mixing at the beginning of the shift, and possibly after the luncheon interval, for a few minutes and as would be expected, when the mixing process was not in operation for any length of time the small lots drawn from the tap tended to become heavy and consequently the blackwash got progressively thinner. Moulders were instructed to empty their blackwash buckets back into the tank so as to clear out the heavy cake which grows on the bottom, in the interests of economy, but unfortunately they sometimes forgot to remove the hemp swab before doing so, and this caused the partial dismantling of the tubing to get the system freed again. To guard against this a wire grid was suspended below the surface level of the liquid, but after a time this was discarded as it impeded the mixing process.

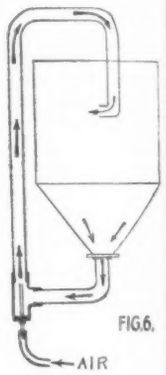
Water was connected to the tanks for convenience, and it was soon observed that with the plug cocks closed water leaked quickly from one tank into the other. The wear was due to the action of the blacking between the sliding surfaces, and when this leakage developed the plug cocks had to be renewed.

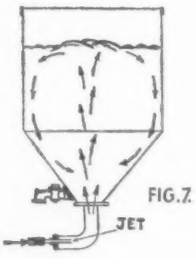
The pump impeller, although very robust, also wore out and, of course, the efficiency dropped off considerably before complete renewal was necessary. It is possible that extremely rapid mixing might have been sacrificed in the interests of longer life and less repairs, because the pump seemed to deliver the blackwash under considerable pressure, *i.e.*, much more than was strictly necessary. The most serious trouble from wear, however, arose from the difficulty of keeping the pump spindle packed tightly. Even with frequent renewal of the packing, the spindle became worn unevenly into grooves—and the leakage was thereafter constant in spite of frequent packing. Water tended to leak away, the mixture became concentrated and the surrounding floor was always covered with blackwash.

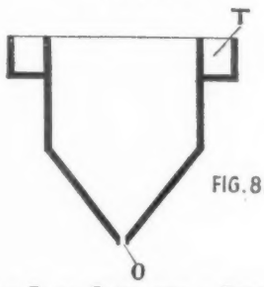
It may be argued that the savings in wages for mixing time as compared with hand mixing would allow of replacement parts being bought at reasonable intervals. On the other hand, special materials might be used in order to give increased wear resistance. However, it seems safe to say that in most foundries the mixing time by hand, even though excessive, would excite less attention than regular appearance of invoices for replacements.











FIGS. 4-8.—FIG. 4, DESIGN OF A COMMON PLUG COCK WITH A RESTRICTED BORE THROUGH THE PLUG; FIG. 5, VALVE SUITABLE FOR RUNNING OFF BLACKWASH; A, VALVE SEAT IN RING FORM; B, RUBBER WASHER. FIG. 6.—CIRCULATION BY COMPRESSED AIR, INJECTOR TYPE. FIG. 7.—CIRCULATION BY COMPRESSED AIR, SIMPLIFIED TYPE. FIG. 8.—CUP VISCOMETER; O, ORIFICE; T, ANNULAR TROUGH.

On considering this matter of replacements carefully, it became obvious that the six plug cocks were a source of trouble, which was a matter of individual design and/or elimination where possible; secondly, that the leakage at the pump spindle would be due to the head of water acting, and consequently, if the pump were raised, this leakage would be reduced. If, on the other hand, the pump were eliminated altogether, the trouble would disappear.

Types of Control Valve

The plug cock type of valve (Fig. 4) is the commonest on the market, but is not suitable for blackwash. The action of turning off the liquid smears the blackwash into the space between the machined surfaces, thus wearing a ring clearance through which water can bypass round the plug in the closed position. Where two tanks are connected to a pump, this leakage of water from one tank to another causes trouble in mixing.

A plain type of valve, such as is used for heavy oil (Fig. 5), would be more suitable, provided it has a leather or rubber washer to ensure a tight joint when closed. If the bore at the smallest part of this valve is kept as large as possible, say at not less than 2 in., there would be little tendency for it to choke up and less need to clear it by pushing a rod or wire through from outside, as is required occasionally in the case of the plug cock valve.

There is an alternative type, intended for corrosive liquids, in which a rubber tube is incorporated in the pipe line, and the valve principle simply depends on the pinching or flattening of the tube. It might, however, be assumed that the rubber would "perish" in time, and without an actual trial it is impossible to say whether the life obtained would be any improvement on that of the other valves.

Compressed-Air Mixing

During repairs and temporary breakdown intervals compressed air was used in mixing, using a common 36-gall. wooden barrel to mix and contain the blackwash, into which was thrust an iron pipe connected to the air supply by means of a rubber hose and the usual off-on control valve.

The mixing, after the primary wetting of the dry materials was achieved, was erratic, since the common tendency was to use too much air and to "boil" the blackwash out of the barrel. As this type of power is easily handled, cheaply adapted, and requires no moving parts, it was decided to adapt it to this purpose, at the same time eliminating the undesirable features. The common wooden barrel is really too small for mixing a reasonable quantity; is rather awkward to mix in, and the distribution of compressed air uneven and inefficient, and for the most part wasteful.

The first idea (Fig. 6) tried was an adaptation of the injector to produce a sort of artesian well, by blowing high pressure air from a small jet upwards from the bottom of a vertical tube having a "T" piece branching off the bottom of the tank. By this means it was hoped to cause a circulation of liquid from the bottom of the tank up the tube to the top of the tank.

This was constructed with standard 2-in. pipe fittings, and did actually operate as expected, but the system would require considerable improvement in design. It is unlikely that it would have worked without some assistance in the initial stage of mixing, and the material tended to settle badly owing to the direction of flow. Settling of the solid material to the bottom of the conical vessel would, on choking, be aggravated by the suction in the same direction, but it was intended to close the top or delivery end of the tube and divert the air

Mould and Core Washes

pressure in the reverse direction to clear the obstruction when necessary. This alone would be a welcome improvement on the high-speed circulating pump system which tended to pack the sediment harder, and after a week end there was often considerable trouble in restarting.

The experiment with the injector type of system was followed by a simpler design, which consisted of a jet of air introduced at the bottom of the vessel of the same conical design. The airline was fitted with a small screw valve of suitable design which incorporated rubber valve-facings. This allowed a very low air-consumption, the movement of the liquid being just sufficient to prevent continuous settling while the blackwash is being used and at the initial mixing stage, the air can be turned on so as to produce violent boiling if rapid mixing be desired. This system is now in continuous operation, making 60 galls. every day except Saturday. The usual practice is to mix a new batch of blackwash and leave it overnight while the previous batch is still in use, so that there is no break in the continuous supply.

A typical mixture in use at present is:—

Blacking ..	.. 224 lbs.
Plumbago ..	.. 12 lbs.
Bentonite ..	.. 20 lbs.
Water ..	.. 500 lbs.

The tank is filled with water to measured level by means of a gauge stick, the air turned on to produce a violent boil, and the dry materials added and dispersed. The whole operation of mixing takes about 35 mins., at the end of which time there is still evidence of small lumps, but since these are all at the top they would present no trouble even if the blackwash were used immediately since the liquid is drawn off from the bottom of the vessel. After 35 mins. mixing the air is turned down to a minimum, and presumably these few remaining small lumps become water-logged, and are then dispersed in the gentle current of liquid. The quality of smoothness in the blackwash improves to its best in about two hours after mixing. There are a number of advantages in this form of mixer. There are of course no working parts to wear out, and only one valve to each tank which might require replacement. The direction of flow in mixing, being upwards, automatically clears the bottom of the cone of settled solid material and any settling material returns to the concentrated part of the current caused by the air stream. The simple construction of this mixing unit makes the first-cost low. The cost of running continuously is very low. Careful measurements of the actual volume of air used in mixing were made as well as measurements of the current consumed in producing compressed air at 90 lbs. per sq. in., and from these figures it was found that the cost of running at low pressure after the initial mixing stage was one penny for three hours.

Methods of Testing Blackwash

Defects in mould surfaces often throw suspicion on the blackwash used and previously the blackwash mixture would be blamed or exonerated equally without evidence of any reliable kind being available and this lack of any test-method usually kept the foundryman using a certain brand of blacking exclusively, irrespective of price and afraid to make any change.

The use of controlled mechanical mixing methods made it easy to reproduce the exact conditions each time and so blackings could be prepared and compared on exactly the same footing. It was thought desirable to develop some form of routine tests which could be applied at a moment's notice in order to detect careless interpretation of instruction regarding weights of materials given to workmen.

Specific gravity is the first obvious method and several forms of hydrometer, including some specially made, were tried but these were discarded, being found very unsatisfactory since the hydrometer usually failed to respond to very obvious changes in concentration and the reading of these instruments in blackwash is anything but accurate.

The specific gravity bottle was also used. The usual size is unsuitable and that used was a 1,000-m.l. volume. To measure specific gravity by this method takes much longer than the measurement by hydrometer but provided that it is done carefully the figures are accurate but are extremely insensitive to heavy additions of solid material to the blackwash. This is unavoidable where these materials themselves have such a low specific gravity.

Viscometer Measurements

In his Paper dealing with oilsand core manufacture, Sheehan illustrated a viscometer which he had used but did not give a detailed description, which would be helpful in obtaining or making one. After a little trouble, however, the author obtained one which appears to be the same (Fig. 8). It consists of a brass cup with a conical bottom, a definite volume of 113 m.l. and having an orifice 0.146 in. diameter. A trough runs round the top so as to catch the overflow on filling completely. Its application would consist of rapid checking of any particular lot of blackwash to test for undue settling, improper mixing, or unauthorised changes in the proportions of materials. The value of such a test is more important than may appear at first sight because the fact that an immediate check is available acts as an efficient deterrent on carelessness in measurement of materials used. The manipulation of this viscometer is simple and the results very satisfactory; for example, the triplicates of measurements made are five times out of ten exactly the same and when variations do occur they are of the order of 17.2, 17.0, 16.9 seconds, or 15.0, 15.0, 14.8 seconds. The time for each measurement of viscosity is about 20 seconds whereas specific gravity by weight takes a considerable time and although the hydrometer is as fast, the results are useless. In order to test the sensitivity of the test by viscometer to changes in the blackwash, a convenient sample was taken and diluted progressively with water, thus altering the percentage of solid materials, and the results are expressed in the graph, Fig. 9, showing that small alterations of concentration affect the viscosity reading considerably. It was found that water gave a reading of 10.4 seconds and consequently as the graph approached this figure large additions of water would make less difference. However, at normal concentrations the viscosity test is very sensitive. Though some foundries use a much heavier blackwash than 17 seconds yet it is felt that the viscometer will apply equally well to all these mixtures.

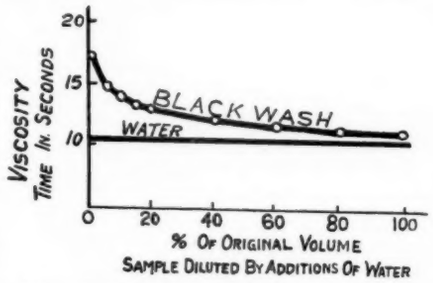


FIG. 9.—SHOWING SENSITIVITY OF THE VISCOMETER READINGS TO CHANGES IN BLACKWASH.

In sampling for this or any other test on blackwash it is of course essential when taking the sample, to see that it represents the batch to be tested and the sample should be drawn while the liquid is actually mixing, unless in cases where it may be desired to test the rate or degree of settling when samples would be drawn at different levels as required.

The usual procedure would be to run off at least the volume of the delivery pipe, return it to the tank, and then run off the sample. To keep the sample uniform during testing it is best to pour it quickly from one container to the other immediately before filling the viscometer. The orifice is closed by placing the finger under it and filling the cup till it overflows into the annular trough, then using the stop watch, to take the exact time from the instant of release till the small stream breaks. With blackwash there is no doubt about the end point as the stream ceases very sharply.

Check by Analysis

In making blackwash and testing by the old method of dipping the hand into the liquid and gauging its quality by what stuck to the back of the fingers, it is doubtful what property was actually tested, if indeed anything was tested at all other than a rough idea of the concentration, and perhaps some idea of clay content, where this is added, measured by colour. It was thought worth while to attempt some form of rational analysis by which a sample could be resolved into its relative percentages of water, blacking and clay. This was done by first taking a known weight of blackwash and filtering off the solid material which gave the correct proportion of water to solids. The original materials, blacking and clay, were then tested for "loss on ignition" at red heat, and this loss would include water of combination and volatile matter. With this information available, the loss on ignition of the mixture of blacking and clay filtered off from the sample is obtained, and the proportions of clay and blacking found by calculation, as in the following example.

Weight of sample of blackwash = 122.64 grms.

Weight of clay and blacking in sample = 45.344 grms.

Therefore 100 grms. of sample contain 37 grms. of clay and blacking.

Loss on ignition on the mixture of dry clay and blacking, 82.98 per cent.

Loss on ignition of "Colbond" = 18.05 per cent. (as received).

Loss on ignition of blacking = 85.38 per cent. (as received).

In order to find the proportions of clay and blacking: Let x = percentage of clay in the mixture, and $(100 - x)$ = percentage of blacking. Then $18.05\ x$ = loss due to Colbond; $85.35\ (100 - x)$ = loss due to blacking.

$$\text{Now } \frac{18.05\,x + 85.38(100 - x)}{100} = 82.98$$

$\therefore\ x = 3.56$ per cent. (clay in dry solids).

Therefore:

Clay in blackwash sample = 1.32 per cent.

Blacking in blackwash sample = 35.68 per cent.

Water by difference = 63.00 per cent.

After extended trial this method of check by analysis based on the method illustrated appears to be reasonably satisfactory, and as an occasional check has been found very useful.

Magnetic Thickness Gauge

A magnetic gauge accurate to 0.001 in., developed by the General Electric engineering laboratory, measures the thickness of sheet steel when only one side is accessible. It consists of a 7-lb. portable indicating unit, connected to an electric outlet, and a small cylindrical head containing a magnet. When the gauge head is placed against the material, the amount of magnetic flux that passes through the gauge-head magnetic circuit indicates the thickness of the material. Any magnetic sheet or plate material may be measured as long as the material is not backed by other magnetic material.

The American Metallurgical Scene—2

Revised U.S. Classifications

PIG-IRON AND CAST-IRON PIPE

Both to reduce the number of iron and steel specifications in use and enable makers to expedite deliveries to consumers, and to facilitate the getting under way of the defence programme as rapidly as possible, the American Iron and Steel Institute has for some time been making a careful study of the wide ranges of pig-iron, cast iron and steel alloys which are produced in the United States. New classifications have been drawn up as a result of these investigations, and have recently been published. Recent revised classifications for pig-iron and cast-iron pipe are noticed below; the revisions for alloy steels were summarised in the FOUNDRY TRADE JOURNAL of June 12 last.

Pig-iron

A new classification of pig-iron by grades has been formulated by the General Technical Committee of the American Iron and Steel Institute and published in a manual entitled "Standard Pig-iron Compositions of the American Iron and Steel Industry and Their Grades, Chemical Compositions and Common Uses." Copies of the booklet may be obtained from the Institute, 350, Fifth Avenue, New York, at 25 cents each.

The list, says "Steel," contains 257 compositions. Included are 26 low-phosphorus, 24 intermediate low-phosphorus, 8 Bessemer, 47 malleable, 6 basic, 42 Northern low-phosphorus foundry, 42 Northern high-phosphorus foundry, 14 Southern foundry and 48 silvery pig-iron analyses. Each composition is identified by a prefix letter, six numerals which indicate the analysis and, in some cases, a suffix letter.

For convenience of reference, a prefix letter is used to designate grades in order of increasing phosphorus content, as follows:—

Designation.	Percentage P content.
A. Low phosphorus	0.035 max.
B. Intermediate low-phosphorus	0.036 to 0.075
C. Bessemer	0.076 „ 0.100
D. Malleable	0.101 „ 0.300
E. Basic—Northern	0.400 max.
F. Foundry—Northern, low-phosphorus	0.300 to 0.500
G. Foundry—Northern, high-phosphorus	0.501 „ 0.700
H. Foundry—Southern	0.700 „ 0.900
J. Basic—Southern	0.700 „ 0.900
S. Silvery	0.300 max.

Silicon and manganese contents are designated by a six-number system in which the first three numerals designate the average silicon content; average manganese content is similarly indicated by the last three numerals.

For example, A 113088 identifies an iron having phosphorus content of 0.035 per cent. maximum, silicon content of 1.00 to 1.25 per cent. (denoted by 113) and manganese content of 0.76 to 1.00 per cent. (denoted by 088). The new system easily can be used with the aid of the manual.

The new standard list, it is expected, will enable pig-iron producers to expedite deliveries and improve their service to consumers in general. It also will simplify the blast furnace stocking problem. One producer recently had more than 1,200 different grades in storage in as many piles. Several others have had 900 to 1,100 grades in stock. Under the new standard pig-iron compositions set-up stocks should not average more than some 100 different piles.

Cast-iron Pipe

A recent memorandum in connection with current progress of the Sectional Committee on Specifications for Cast-Iron Pipe, organised under the American Standards Association procedure and sponsored by four societies, the American Gas Association, the American Water Works Association, the New England Water Works Association, and the American Society for Testing Materials, indicates that specifications for four types of pipe other than pit-cast pipe have been drafted, based to a large extent on the specifications for cast-iron pit-cast pipe for water and other liquids (A44-39T), A.S.A. No. A21.2-1939, states the "ASTM Bulletin." These pipes would be centrifugally cast in metal moulds and in sand-lined moulds, and material horizontally cast in green sand with multiple gates and in green sand having tapered machined bolted joints. These drafts have received the consideration of producers and consumers and the technical sub-committee concerned.

To make a number of the requirements for pit-cast pipe adaptable for the needs of the gas industry, certain work has been accomplished which it is expected will result in recommendations to the sectional committee. Standardised requirements for tar-dip coatings have been approved by the section in charge and will be offered to the main committee. A joint committee formed of members of Sectional Committee A40 and A21 has completed a draft of proposed specifications for threaded cast-iron pipe for drainage, vent and waste services.

American Foundrymen and Defence

Mr. L. N. Shannon, retiring president of the A.F.A. and president of Stockham Pipe & Fittings Company, Birmingham, Ala., at the Association's recent annual convention in New York, referred in fitting terms to the aims and solidarity of American foundrymen in the present world emergency. In the course of his address, he said: "The fundamental work of the Association—improvement and development of the casting industry along lines of technical control, manufacturing methods, equipment and shop processes—has been of great importance in placing our industry on a footing whereby it can do its share in the nation's industrial preparedness programme. . . . . You and I are aware of the place our Association has in the national programme. With our records of recent years to aid in putting our plants on the highest peak of production, with our great force of research workers to give us new equipment, new methods, better castings, we will meet our obligation. We are a great force. Following our motto:

'Coming together is a beginning,
Working together is progress,
Keeping together is success,'

we, the American Foundrymen's Association, stand ready to do our part and more than our part."

Magnesium Castings

Magnesium foundry practice in the United States was discussed at the recent annual convention of the American Foundrymen's Association by M. E. Brooks and A. W. Winston, of the Dowmetal Foundry, Bay City, Mich. They retraced the developments in magnesium foundry practice since 1935, and estimated that the output of magnesium alloy castings would this year exceed 4,000 tons. They divided their Paper into seven parts: (1) Moulding sands, which covers the use of both the natural and synthetic moulding sands; (2) sand agents, substances used as inhibitors in foundry moulding and core sands; (3) cores, covering binders used, the use of inhibitors, typical core mixtures, pasting practice, the use of chills, and storage; (4) moulding practice, which describes the use of filters for oxide films, pouring basins and gating and risering; (5) melting practice, including the open flux-pot and crucible methods and describing under the latter, type of crucibles and furnaces used, melting procedure, fluxing, heating and pouring, cleaning the crucible, charges, temperature control, and large scale melting units; (6) casting finishing, in which is discussed removal of gates and risers, heat-treatment, heat-treating furnaces, cleaning methods, and pickling treatments; and (7) alloys, in connection with which a table gives the compositions, characteristics, and mechanical properties of magnesium sand castings. The authors pointed out that introduced on a practical scale in 1929, the production of magnesium alloy sand castings increased tenfold during the following decade to reach more than 500 tons in 1939. It is estimated that production in 1940 rose to about 2,000 tons and will more than double again during the current year. At least a score of foundries are casting magnesium.

Conservation of Ferro-Manganese

According to a report prepared by the Technological Committee on Manganese of the National Academy of Sciences, under the auspices of the Office of Production Management which was appointed last year to review projects for the development of new processes for recovery of manganese from low-grade domestic ores, about 20 per cent. of the consumption of ferro-manganese can be saved by emergency conservation, *i.e.*, the substitution of spiegel for ferro-manganese, and closer co-operation between producers and consumers.

The American iron and steel industry, when operating at about 90 per cent. of capacity, requires annually about one million tons of high-grade manganese ore (50 per cent. manganese), nearly all of which has to be imported. The amount actually used (about 15.6 lbs., 80 per cent. ferro-manganese per net ton), it is pointed out, is largely the result of accumulated experience, *i.e.*, a desirable balance between the additional cost of manganese to give a better product and the cost of rejects in manufacture due to the use of a lower percentage of manganese. The tendency in recent years has been to increase the manganese content.

With regard to the consumer, it is suggested that he might relax his requirements from the point of view of surface finish, etc., for there are many instances where an indifferent surface can be produced, and consequently less manganese consumed without affecting the fitness of the steel for a specific application. In this way, it is estimated that 20 per cent. less ferro-manganese would be required.

Attention is also called in the report to the amount of manganese carried away in slags and not commercially recoverable, and also to the possibility of retaining some of the manganese charged in the raw materials. The desirability of concentrating low-grade ores and of utilising manganese-bearing metals is also considered, while a greater use of spiegel is advocated, and the possibility of developing a spiegel with a higher Mn content is also mentioned.

The report concludes that if a spiegel containing 35 to 40 per cent. Mn were used and manganese limits lowered as an emergency measure, the ferro-manganese requirements could be reduced by at least 40 per cent.

New U.S. Magnesium Castings Plant

The U.S. Defence Plant Corporation is to provide more than $1,000,000 for buildings, etc., for use of the Bendix Aviation Corporation, South Bend, in the manufacture of magnesium castings.

Foundry Technique for High-Strength and Other Types of Alloy Grey Iron Castings

DISCUSSION IN LONDON

New and interesting uses for acicular or pseudo-austenitic cast iron, the latest development in this field, were disclosed in the discussion on McRae Smith's lecture to the London Branch of the Institute of British Foundrymen.* In order that readers may have a proper understanding of the nature of Grade 4 cast iron, an abstract of the governing B.S. specification is given on page 72 of this issue. Included also is some new material provided by Mr. Rowden as a written discussion. The discussion was opened by MR. PINCOTT, who, after congratulating the author upon his Paper, said he had gained his first knowledge of acicular cast iron at the time when experiments on cast crankshafts were being carried out by a Northern metallurgist, who had obtained some rather staggering figures; having since been able to make a number of experimental casts, Mr. Pincott said he had to agree that results such as those referred to were obtainable.

Spanners Made in the New Iron

Describing a rather amusing and interesting experiment with which he had been concerned, he recalled that, in connection with the supply of refrigerating machines, together with their tool kits and spare parts, he had experienced great difficulty in obtaining supplies of forged steel spanners. Until that time he had visualised cast iron spanners only of the type used for assembling beds and probably clothes wringers, and so on. However, some spanners of the standard type were made in the new iron, the sizes being ¼ in. to $\frac{15}{16}$ in., ⅜ in. to ½ in., ⅝ in. to ¾ in., ⅞ in. to 1 in., and some 1.2 in. dia. test-bars were also cast. The tensile strength of that particular cast—it was not the first cast, incidentally—in the as-cast condition was 27 tons per sq. in.; the modulus of rupture was 47 tons, and the Brinell hardness was, roughly, 340. After heat-treatment at 350 deg. C., holding that temperature for 1 hr. and cooling in the furnace, the tensile strength of the spanners was 32½ tons per sq. in., the modulus of rupture was 57 tons and, strangely enough, the Brinell hardness number was reduced to 300. In view of that experience, he asked for further information on the mechanics of the heat-treatment and its effect on the structure.

The tool-room foreman and his assistants had commenced their tests of the spanners by dropping them on the floor and subsequently by throwing them down, but they did not break. Then they had extended the tests, using a bolt, 2 or 3 in. long, held in a vice, and pulling the nut tight by means of the spanners. Finally, a 2-ft. length of tubing was placed on the end of the spanners, and the nut was pulled up tight, but the bolt had sheared and the spanners had not broken. They could be broken only by severe hammering, and all who were concerned with the experiments had been amazed by the results; even so, the spanners broke only through the jaws at the corners, where the section was relatively shallow. He confessed that in the course of those experiments he had found the iron particularly easy to handle and to work in the foundry. During the last four or five years he had been concerned with the making of cast iron crankshafts and, in view of the difficulty of obtaining steel forgings, the acicular iron was being used for extending the range of cast crankshafts. Everyone concerned seemed entirely satisfied.

With regard to the heat-treatment of relatively large castings in acicular iron, he asked if it were possible to use for that purpose a mould-drying stove, provided it was of fairly modern design, based on the forced-draft principle.

Stress-Relieving Heat-Treatment

MR. MCRAE SMITH, replying to the question concerning the heat-treatment of the acicular type of iron, said it would appear, from his own personal experience—and he believed that the work by the authority quoted by Mr. Pincott confirmed it—it was not amenable to the ordinary pearlitic cast iron treatment. However, with stress-relief annealing at about 350 deg. C., one obtained increased tensile strength, probably with some modification of structure, because there might be some austenite present in the cast-iron conditions as well as the pseudo-martensite. It was rather surprising that the Brinell hardness figure of the material mentioned by Mr. Pincott was reduced as the result of heat-treatment. He had not expected to hear that. Perhaps the temperature was slightly higher than 350 deg. C., or perhaps even a temperature of 350 deg. C. was a little too high for the composition of the metal dealt with. Bearing in mind that the tensile strength was increased, he said that perhaps there was a little pearlite in the structure which had resulted in the reduction of the Brinell figure to about 300.

The heat-treatment of such irons at relatively low temperatures was visualised; therefore, the ordinary foundry stove capable of giving even only 250 deg. C. would probably be quite suitable for giving that treatment.

Completing American Research Work

MR. V. C. FAULKNER asked, on behalf of Mr. G. R. Webster, whether the author favoured the use of receivers for dealing with the type of iron discussed in the Paper. Recalling that 0.4 per cent. was regarded by Americans as a high phosphorus content in cast iron, whereas we in this country were using percentages up to 1.7 per cent., Mr. Faulkner suggested that the enormous amount of American research work which had been devoted to cast irons had had a profound effect upon our views concerning phosphorus content. It was up to the British, he said, to go further and to complete a good deal of the work which had been carried out by the Americans. Apparently in America there were but few irons containing more than 0.4 per cent. of phosphorus, and the Americans were amazed when they heard that we were using as much as 1.6 per cent. Finally, he mentioned that, in his experience, the melting of cast iron in the ordinary electric arc furnace was difficult, and he suggested that infinitely better results were obtained by duplexing from the cupola.

The Question of Receivers

MR. MCRAE SMITH replied that he did not favour the use of receivers for dealing with high-duty cast iron. Indeed, he personally did not like using ordinary receivers at all for cast iron, and contended that, using a cupola having a well of reasonable size, *i.e.*, a well capable of taking care of two charges at a time, one secured far better control than when using receivers. Most of the receivers installed in this country were for cupolas rated at, say, 4 tons per hr. and over, and the cupolas would have receivers with capacities ranging from 4 to 10 tons, or something of that order. The ordinary iron foundries of this country did not make use of individual receiver ladles of the American barrel type, which could be externally heated and used for superheating or for retaining the temperature of the metal at a definite level. These were excellent, and their use should be greatly extended in this country, but he did not like ordinary receivers.

The fact that in America the maximum phosphorus content was rarely over 0.4 per cent. in cast iron, and that 0.4 per cent. was regarded as a high phosphorus content, was due to the limitations of the types of iron ore available and pig-iron produced there. In the southern foundries of U.S.A. a small amount of pig-iron having a phosphorus content of approximately 0.7 per cent. was obtainable, but normally the phosphorus content was less than 0.4 per cent. The machine tool industry in this country provided a very good example of what could be done. The ordinary machine tool castings trade made extremely good castings with high-phosphorus iron, but for very complicated castings the material used should be comparable with the American iron. After all, a great many of the machine tool designs were of American origin, and such castings had been made in America in low-phosphorus iron. Naturally, therefore, makers of such castings in this country also preferred low-phosphorus iron. In view of the exigencies of the present time an endeavour had to be made to use high-phosphorus iron for additional types of castings, but it was extremely difficult, and it was necessary to modify foundry practice very much to ensure complete freedom from liquid shrinkage defects in complicated castings of diverse thicknesses.

For specialised products, such as automobile cylinder liners, piston rings, and so forth, fairly large tonnages of high-duty cast iron were being melted in electric furnaces, but he did not think that much was being converted from borings. The electric furnace was also being used for duplexing.

MR. W. F. ROWDEN said he also would like to congratulate Mr. McRae Smith on his very valuable Paper. High-strength irons of the type that had been described were very extensively used in the United States for many applications, the total carbon and silicon contents being generally on the upper limits of the specifications given. The lecturer had rightly stressed the fact that high strengths were obtainable in the "as-cast" condition. An increase in tensile could be obtained by oil quenching and tempering; thus an iron having an "as-cast" tensile of approximately 30 tons could be increased to 40 tons by oil quenching, following by tempering between 350 and 400 deg. C., but it was impracticable to oil-harden certain complicated sections and, in addition, the necessary equipment was not always readily available.

He asked for Mr. McRae Smith's opinions on the desirability or otherwise of the inclusion of an impact test in the high strength specifications, also what minimum impact value he would advocate.

A recent interesting application demonstrating the utility of these high strength irons was instanced in their use as shanks for carbide cutting tools, to replace steel.

Written Discussion on Mo Cast Iron

With regard to Mr. McRae Smith's remarks, also those of a previous speaker, on the importance of phosphorus, especially at the present time, some experimental work in this connection had been carried out by the Climax Molybdenum Company using 30-lb. laboratory high-frequency melts having a base composition of: T.C. 3.14; C.C. 0.66; Gr. 2.48; Si, 1.95; Mn, 0.75; S, 0.080; P, 0.015; and Mo, 0.03 per cent.

* *See* F.T.J. of March 20 and 27, and July 10, 1941.

High-Strength Grey Iron Castings

To this iron was added 0.5 phosphorus, 0.5 phosphorus and 0.5 molybdenum, and 0.5 phosphorus and 1.0 per cent. molybdenum. Analyses and mechanical properties are shown in Table A.

TABLE A.—*Mechanical Properties of Mo Cast Irons.*

	A. Base iron.	B. 0.473 P.	C. 0.470 P. 0.49 Mo.	D. 0.468 P. 0.99 Mo.
*Transverse, lbs.	2,600	2,830	3,060	3,020
Deflection. Ins.	0.291	0.268	0.234	0.205
Modulus of rupture. Tons per sq. in.	30.7	33.9	36.1	35.6
B.H.N. (1.2 in. dia.)	215.0	245.0	262.0	277.0
†Tensile. Tons per sq. in.	19.4	21.6	24.1	24.9
Impact. Ft./lbs.	43.0	26.0	31.0	31.0

* 1.2 in. dia. × 18 in. centres. † 0.8 in. dia.

It will be seen that, whilst there is a fall in impact values with the addition of phosphorus, with molybdenum additions impact is maintained, and of interest is the fact that the structure of the iron (D) was found to be somewhat acicular in nature. The graphite distribution was practically acicular in nature, and was nearly the same for all four melts.

Further laboratory melts produced in a Detroit Electric Rocking furnace have also been made using a somewhat different base iron as below, to which varying increments of phosphorus were added up to about 1 per cent. Complete analyses and mechanical properties are given in Table B.

TABLE B.—*Composition and Properties of Mo Cast Irons.*

Analyses (base iron)	1.	2.	3.	4.	5.	6.	7.	8.
T.C	3.46	3.36	3.27	3.11	3.27	3.14	3.14	3.08
C.C	0.87	0.76	0.63	0.66	0.75	0.72	0.77	0.67
Gr.	2.59	2.60	2.64	2.45	2.52	2.42	2.37	2.41
Si	1.44	1.41	1.45	1.45	1.45	1.43	1.45	1.40
Mn	0.62	—	—	—	—	—	—	—
S	0.097	—	—	—	—	—	—	—
P	0.019	0.175	0.321	0.471	0.585	0.664	0.872	1.01
Mo	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Mechanical properties.								
Transverse. Load, lbs. (1.2 × 18 in.)	2,990	3,120	3,120	2,925	2,970	2,660	2,550	2,330
Transverse rupture. Tons per sq. in.	35.2	36.8	36.8	34.5	35.0	31.4	30.1	27.5
Deflection. Ins.	0.374	0.355	0.306	0.272	0.253	0.208	0.189	0.165
B.H.N. 1.2 in. dia.	223.0	228.0	228.0	241.0	241.0	241.0	255.0	255.0
Tensile. Tons per sq. in. (0.8 in. dia.)	22.8	23.0	25.0	23.5	24.4	21.1	22.4	20.6
B.H.N. (0.8 in. dia.)	217.0	228.0	228.0	235.0	241.0	241.0	241.0	241.0

Variation of the total carbon content will be noted, which will undoubtedly account in some measure for the variation in the mechanical properties. These data may provide a useful basis for further experimental work.

Impact Tests for Cast Iron

MR. MCRAE SMITH replied that, unfortunately, there was no standard impact test for cast iron, and he felt it was time that the evolution of a standard test was considered. However, there had been grave difficulty in evolving a simple test. His method was to machine a 1.2 in. dia. test-bar down to 1 in. dia. and to make a 0.05 in. semi-circular groove—not a notch—so that the diameter in the groove was reduced to 0.9 in. On this test-bar the high-duty cast irons should give minimum impact values in the region of 24 to 30 ft.-lbs., whereas in the pearlitic irons the maximum obtained in the same manner was about 16 ft.-lbs. In the case of the high-phosphorus irons, the figure was about 5 to 7 ft.-lbs. However, one could not think of putting that forward for specification purposes until the authorities had decided a standard design of test-bar and conditions of testing.

With regard to tool holders, he said he had heard recently of some small complicated holders which had to be made urgently for small automatic lathes. Those components were not designed for production in cast iron, and normally one would use 0.35 or 0.4 per cent. carbon steel; but nickel-molybdenum Ni-tensyl iron had been used, and the castings had proved to be very successful. Again, he had heard recently of the application of that type of cast iron to the making of tool shanks for tipped tools. There it was a question of practical economics. If one could obtain steel more easily and more cheaply, one should use it, but it was nice to know that a substitute material was easily available in the event of a temporary scarcity of steel shanks.

MR. FAULKNER suggested that one should not visualise shock tests for cast iron until the steel foundry industry had adopted such tests for their specifications.

Tool Holders to Eliminate Chattering

MR. R. B. TEMPLETON (Branch-President-Elect) said he had found that, where high-duty cast iron was used for making tool holders, its high damping capacity was very valuable, for it prevented a good deal of the chipping of the tool.

MR. MCRAE SMITH was particularly interested in Mr. Templeton's experience, because it was a fact that, if one used a heavy tool of about 2 in. by 2 in. section made in 18 per cent. tungsten steel, with a long shank, on a heavy face plate lathe, there was often a tremendous amount of chatter, no matter how much care was exercised in securing the tool. He felt that the founders might be able to help the engineering trade a great deal by looking much further into the problem of tool shanks. The capacity for absorption of vibrations, exhibited by most types of cast iron might prove very valuable when coupled with materials having tensile strengths equal to or in excess of that specified in B.S.S. 876, Grade 4. In the present state of knowledge, cast iron shanks would probably have to be confined to the larger sizes, say 1 in. by 1 in. section and upwards.

The Field for C.I. Tool Holders

DR. A. B. EVEREST (Past-Branch-President) stated he had been considering the problem of tool shanks in conjunction with one or two of the big machine tool firms in this country. He said the decision at the moment seemed to be that a high duty cast iron shank had advantages for large tools, but that it was not suitable for tools less than about 1 or ¾ in. square. One of the principal difficulties was that most of the tools had to work in conditions in which there was a fair degree of "overhang," and it was then not considered safe to use cast iron except in the heaviest tools.

After commenting that a committee was being formed to try to arrive at a standard impact test for cast iron, Dr. Everest emphasised the point made by Mr. McRae Smith with regard to uniformity of the structures of castings. It was of no use, he said, producing high-duty irons unless the castings were sound; it was useless having a mass of 32-ton tensile iron around a blowhole. Two vital features of the nickel-molybdenum irons were that they had remarkably uniform structures and had very good casting properties, so that difficulties with unsoundness could readily be overcome.

One firm within his knowledge was using the new nickel-molybdenum type of iron for handles and levers on machine tools; and he emphasised that if cast iron could be used widely for making such parts, in substitution for steel, there were very great possibilities. He had in mind the use of such material for making many details, and even such common parts as cheap scissors, and so on. With regard to specifications, he said that during the last few days the British Standards Institution had commenced circularising engineers in connection with B.S.S. 786, Grade 4.

New Iron has Good Casting Properties

MR. MCRAE SMITH confirmed Dr. Everest's remarks concerning the ease of casting the nickel-molybdenum cast irons, even in the case of castings of fairly complicated sections. Unless such castings were sound throughout, he said, they were useless for their purpose, and he would prefer to use iron of lower tensile strength rather than sacrifice soundness. It was often suggested to the industry that, if common high-phosphorus iron of comparatively low strength were used, one had not to sacrifice strength for soundness. His answer was that the high-duty cast iron specifications usually covered very complicated or lumpy castings, and the castings had to withstand very high stresses and be pressure tight, etc. He did not think that satisfactory castings for that purpose could be made in soft high-phosphorus high-silicon cast iron. If deep machining were necessary they would be hopeless. Unfortunately, the advocates of the phosphoric irons had in mind only the castings for which those irons were suitable, and not castings of the kind for which the high-duty irons were used.

Some time ago some levers for auxiliary control work in diesel engines had been made in high strength nickel-molybdenum cast iron. Previously the levers had been made in steel. Forgings and stampings could not be obtained economically or sufficiently quickly in small quantities, and it was decided to use a high-duty cast iron, involving a cost of about £12 per ton for alloy content. Thus, the same service results were obtained at much lower cost than formerly, in spite of the higher initial cost per lb. of material used, because the high strength cast iron could be cast accurately to shape.

Alloy Additions plus Technique

MR. C. H. KAIN (past-Branch President), speaking as a maker of both steel and iron, said he was delighted that levers and some other things which the steel foundries had been asked to make in the past were now being made in iron. Expressing his strong objection to the use of the phrase "*rough* castings and forgings," he remarked jocularly that, whilst he knew that forgings were not very good—he did not make them—he must challenge the idea, which seemed to be generally accepted, that steel castings were

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necessarily rough. As proof of his contention, he pointed to the modern fighting machines, and said that steel castings were being made to limits of accuracy at least comparable with those of the average grey iron casting. Steel foundry technique had greatly improved during the past ten years, and many sound castings were produced in steel, whereas their soundness would be very doubtful if they were produced in high-duty irons.

Asking for more information of the technique of production of the high-duty irons, he said that whilst engineers were interested in the properties of those irons, the founders were interested particularly in their production; and he believed it would be found that a very great deal of the improvement of the properties of those irons resulted from improved technique of production, as distinct from alloying additions. It should be clearly impressed upon foundrymen that mere alloying additions would not necessarily improve the quality of the irons; unless it was emphasised that improved technique was necessary, there was danger of the foundrymen being led astray. An outstanding instance of that fact was to be found in the statements and figures published by Piwowarski concerning superheating; he believed that many foundrymen had got into difficulties as the result of those statements and figures. Finally, he expressed thanks to Mr. McRae Smith for having devoted his afternoon to the meeting.

Higher Carbon Aids Ease of Casting

MR. MCRAE SMITH, replying, remarked that perhaps Mr. Kain was under some misapprehension. It had been emphasised a number of times in the Paper that the material discussed therein was a supplementary material to steel castings and forgings, and he had never suggested for a moment that if a casting could be produced more cheaply in steel than in the high-duty irons he had been discussing, one should not use steel. He could not remember having used the term "rough steel castings." While he had referred to "rough" forgings from the point of view that they were not forged to close limits, and entailed high machining costs, he said he admired very much the steel castings trade of the present day for the fine steel castings it produced to very close limits. The work that was being done for some types of production reflected very high credit on the steel castings trade.

With regard to the castability of the high-strength nickel-molybdenum cast irons, his contention was that they could be produced with carbon contents in the region of, say, 3 per cent. Therefore, the difficulties associated with low-carbon cast irons did not arise. The cast irons described were much more readily castable than were the cast irons in the 2.4 and 2.7 per cent. carbon range. Such castings were extremely good, and Mr. Kain would have to look to his laurels when producing competitive steel castings.

All with whom he had discussed the matter knew that he held strong views concerning alloy additions, and he did not wish anyone to think that merely by adding any alloying element to any type of cast iron one could produce a good job. One must work upon definitely controlled base compositions. With the high-strength nickel-molybdenum irons the carbon limits were fairly wide and, therefore, they were much easier to handle. It was only necessary in the production of alloy cast irons of this type for the foundryman who possessed a satisfactory cupola, which could deliver really hot metal, to add a carefully weighed and pre-determined proportion of alloy or alloys to a carefully weighed proportion of correct type base metal. With that reservation, he believed that the production of those irons would be open to 60 or 70 per cent. of the foundries of this country, if they cared to go into the matter.

The Nickel-Silicon Balance

MR. FRED GENTLES, referring to the height of the cupola stack, said he gathered that the 15 ft. mentioned in the Paper was intended to be a minimum. In some places it was the practice, he continued, to melt steel and hematite iron as a first charge, and then to run that as a steel mix instead of charging steel direct into the cupola. He asked whether Mr. McRae Smith knew of many places where that practice was followed.

Although references were made in the Paper to cupola melting temperatures, no figures had been given, and Mr. Gentles asked what Mr. McRae Smith would regard as a minimum temperature. Finally, referring to the production of cylinders of sectional thickness varying from 1 in. to 1½ in., in metal having a carbon content of, say, 3.2 to 3.4 per cent., silicon 1.6 per cent., manganese 0.8 to 1 per cent., and phosphorus 0.2 per cent., he asked what Mr. McRae Smith would regard as the minimum addition of nickel to suit the requirements of machinability and freedom from porosity on test pressure, after machining.

Tall Cupolas and Melting Technique

MR. MCRAE SMITH replied that the height of 15 ft. between the centre or top of the tuyeres and the centre of the charging door, mentioned in the Paper, was definitely a minimum; a height of from 20 to 22 ft. would be better. He liked a height of from 18 to 20 ft. in cupolas of between 24-in. and 50-in. internal lining diameter. The melting of steel scrap and hematite to give a so-called steel mix pig was quite a good practice. He had mentioned that as being a suitable method of producing refined or diluted low-phosphorus pig-iron, and particularly as a method of getting rid of the first one or two charges of cupola melted metal which usually had a rather high total carbon content, no matter how much steel scrap was used in the mixture. But it would be wasteful to use hematite with the steel. Why use another low-phosphorus material with it? Under present conditions hematite pig-iron would not be available for ironfounders for melting in that way. Instead he would suggest 60 to 80 per cent. of steel scrap and 20 to 40 per cent. common pig-iron scrap, which would give 0.25 to 0.45 per cent. phosphorus in the final product.

MR. GENTLES commented that there might be carbon pick-up.

MR. MCRAE SMITH replied that one could not carburise above a certain point. The second pick-up of carbon on remelting would be negligible in most cases. As to cupola melting temperatures, he expressed the opinion that there was no cupola anywhere which could give too high a temperature. There was a danger of obtaining weak dendritic patterns by superheating too much in electric furnaces. However, he was of the opinion that one should not tap any metal from the cupola at a lower temperature than about 1,350 to 1,380 deg. C., if possible. One should not worry about too high temperatures, but should ensure that the temperature was never below a certain minimum. In cylinders having a metal thickness of from 1 to 1½ in. he would be inclined to restrict the maximum carbon content to 3.2 per cent. He would not increase it to 3.4 per cent., from the point of view of reduction in wear resistance. The silicon content he would keep to 1.2 to 1.3 per cent., when alloy additions were not used. If one were going to add part of the silicon in the ladle, one could have 1.2 per cent. silicon in the charge, and could add about 0.4 to 0.5 per cent. silicon as a late addition, making the final silicon content about 1.5 to 1.7 per cent. When alloys were added silicon adjustments would be necessary.

A High Impact Test Result

MR. PINCOTT, referring to the standardising of test bars for the Izod impact test, said that, in addition to the bar of 1 in. dia., having a groove of 0.05 in., reducing the effective diameter of the bar to 0.9 in., there was also the British Cast Iron Research Association's test piece, having a diameter of 0.798 in., un-notched. He had not tested the acicular irons in the 1-in. diameter grooved bar, but he had tested them in the B.C.I.R.A. test bar, and had secured results as high as 44 ft.-lbs. In view of the fact that the average figure mentioned by Mr. McRae Smith was in the region of 24 ft.-lbs., obtained with the 0.9-in. bar, he was beginning to doubt the accuracy of his own figure of 44 ft.-lbs. In that connection, he asked what was the effect of a notch or groove, for that must be an important consideration in deciding upon a standard Izod bar for cast iron.

MR. MCRAE SMITH said he was aware that two modified test bars were being used, and the 0.798-in. B.C.I.R.A. bar would give a lower value than the 0.9-in. effective diameter bar. But there was little information available yet on cast irons with acicular structure. Owing to the limited number of tests having been made so far in this country on acicular irons using the 0.9-in. test bar, he had put forward his figures on a very conservative basis. He was not at all surprised that Mr. Pincott had obtained impact values of more than 40 ft.-lbs.

At the conclusion of the discussion, a very hearty vote of thanks was accorded Mr. McRae Smith for his very interesting and important Paper. The vote of thanks was proposed by MR. V. DELPORT (past-Branch-President), who commented on the wide interest of the subject, and seconded by MR. B. B. KENT; and MR. C. CLEAVER took the opportunity to add his meed of praise of the Paper and of the work of the metallurgists who were developing the special irons.

Control of Chrome and Foundry Bonding Materials

The Minister of Supply has made the Control of Chrome, Magnesite, and Wolfram (No. 2) Order and the Control of Foundry Bonding Materials (No. 1) Order, both of which will come into force on July 30. The Chrome, Magnesite and Wolfram (No. 2) Order makes subject to licence the acquisition and disposal of "-basic or neutral refractory material," defined as including bricks, refractory cements and other refractory materials containing any compound of magnesium or chromium, other than those manufactured wholly from dolomite.

The Foundry Bonding Materials Order subjects to licence the acquisition and disposal of bentonite and Colbond, and fullers' earth except for the following uses (exempted under Direction No. 1 under the Order): Dyeing and processing of textiles; oil purification, fat purification; paint and pigment industry; paper or board making, and pharmaceutical preparations.

In addition to the materials coveerd by these two Orders, the Chrome Controller will in future be responsible for the production and distribution of dolomite with a view to ensuring adequate supplies and the most advantageous use of the material. It is not considered necessary at the present time to regulate the sales of dolomite by licence. Any inquiries arising out of this Notice should be addressed to the Chrome Ore, Magnesite and Wolfram Control, Ministry of Supply, Broadway Court, Broadway, London, S.W.1.

Rapid Changing of Tuyeres

By means of a V-shaped trolley, blast-furnace tuyeres can be changed in 4 to 5 min. instead of 8 to 12 min., as usually required, according to I. F. GAIDUKOW in "Teori. prakt. met."

Piecework and Production in the Foundry

By A. H. DUTTON.

An interesting article on the above by J. C. Hallamore was published in the FOUNDRY TRADE JOURNAL, May 29, and though the matter was no doubt just fringed by him, there was sufficient to arrest the attention of every foundry manager and cost accountant who happened to see it.

Personal experience shows that the schedule of prices on stages of weights is primarily responsible for the chaos which is prevalent, it is feared, in a number of foundries, and the bewilderment of the intelligent craftsman when faced with a light or intricate job for nothing at all, or an easy job where the price is (as they say) money for old rope, the frantic efforts of the manager to try and balance these anomalies, and the almost impossible task of placating his best men, because, as a rule, they are confined to the tricky work generally with uneconomic prices, whereas the ordinary weighty common variety of castings can be readily undertaken by men of mediocre ability.

A buyer when confronted with a request for a bit more money for the intricate class of work will usually trot out somebody else's schedule, and say, "Well, I can buy them from so and so," who is probably not so acutely conscious of the true position, and it is presumed that these people are the "mugs" to whom Mr. Hallamore refers. It is very often the case that the expensive work piles up as a consequence of picking and choosing from the order-book in an endeavour to make ends meet, and this is usually the precursor of further trouble with regard to delivery, etc.

It is not intended to enlarge upon the ills to which many foundries are subject, but these things are mentioned just to indicate that the same ills are met by us all, and that they are peculiar to foundries, and probably arise from the same disease, lack of knowledge with regard to costs and the persistence of some managements to cling to old ideas, including the indiscriminate allocation of charges which are fairly heavy in a foundry of any size.

In conjunction with the costs department a system was introduced whereby all jobs were taken on their individual merits, that is, on the amount of productive labour required to produce them, which means, moulding, coremaking and fettling, and the charges relating thereto, the basis of allocation being productive wages (excluding gift allowance for overtime). On the other hand, the metal is probably the only thing which is equal to all castings, paying due regard to heads and runners, that is of course provided the mixture is the same, there being different prices of metal, such as hematite, No. 3, and scrap, etc., according to the requirements of the castings, everything else remaining the same, melting, wages, coke, limestone, etc., and the charges relating thereto embodied in a rate per ton of gross chargings into the cupolas, each similar cast being recorded and the whole costed on the monthly period and giving a flat rate of net castings produced in each section. It will be interesting to learn that this figure does not vary above a shilling or two per ton, and it is possible to detect from the cupola cost how this difference has arisen. Here it may be as well to mention how waster castings are dealt with, as this is a source from which great trouble can be traced.

The opinion is that waster castings are a foundry risk, and that every casting made is a potential waster, thus having obtained from experience the cover required against the whole good production, which, expressed as a percentage and included in the net flat rate of charges on the productive wages, takes care of this item. In experience one will find that whatever the percentage was to commence with, it has a tendency to decrease, as carelessness must be eliminated as a result of recording replacement or defective castings, and depriving anybody of the opportunity of burying these in the costs which would be useless for comparison were it otherwise. Whilst the matter cannot be fully dealt with here, and the intervention of the war has curtailed any intention to publicise such a system in detail, in favour of performing and increasing production in a practical manner, it is not beyond the scope of those interested to help themselves as far as possible whilst carrying on with their usual work.

If the manager will confide the whole of his troubles to the cost accountant having some knowledge of foundry practice, they will soon be able to devise a system which will enable them to see clearly past errors, and steer clear of those things which buyers get at such ridiculous prices. It is realised, of course, that he may resort to "pistol-point methods," using the easy stuff as "bait," but it ought not to be difficult to get protection by using the organisations already in being, for this purpose.

In conclusion, may it be mentioned that the support of the directors is required when in quest of the perfect foundry system, and though the road has been travelled far in this direction it must be realised that all foundries must try and shake off their fetters of ignorance and misunderstanding which is largely to blame for their lack of progress. To the interested we would offer some encouragement by informing them that the system in question has to provide for steel, iron, and non-ferrous foundries housed under one roof, which from the costing point of view offers numerous obstacles which were eventually surmounted.

Use of Pitch Coke for Making Chill Castings*

Introducing what is claimed to be a new process for the manufacture of chill castings, K. KNEHANS and N. BERNDT, in "Stahl und Eisen," call attention to the tacit assumption that in preparing the melting charges for making these castings large proportions of special pig-irons are essential. It is also important to arrive at a high percentage of carbon, since the hardness of the castings is a direct function of the carbon content. This carbon is introduced through the medium of high-C special irons which the German industry has in the past imported from Great Britain; in addition, it is not practicable to use a high proportion of broken castings in the charges owing to their high S content and low C. The authors suggest that these two limitations can be overcome by achieving the desired C content, not via the components in the charge proper, but by using a special fuel for melting, viz., by substituting pitch coke for foundry coke in the cupola.

TABLE I.—*Composition of Trial Melts.*

	A.	B.	C.
	Per cent.	Per cent.	Per cent.
Total C in charge	3.60	3.40	3.35
Mixture :			
Special iron I	38	—	—
Special iron II	17	—	—
Basic pig	13	15	15
Hematite	—	30	10
Steel scrap	5	5	5
Broken chill castings ..	25	50	70
Fluxes	Rest	Rest	Rest
Fuel :			
Foundry coke	12	9	9
Pitch coke	—	3	3

Pitch coke, a by-product of coal carbonisation, is stated by the authors to be much harder and denser than ordinary foundry coke, and has therefore a higher resistance to abrasion. Its true specific gravity is between 1.9 and 2; it has less than 0.8 per cent. volatiles and also a low ash, barely more than 0.3 per cent. as compared with 9 to 10 per cent. with foundry coke. It has the very high C content of 98 per cent., and compared with foundry coke has a very low S content, at most 0.5 per cent., compared with 1 per cent. in foundry coke. In view of these advantageous properties, it is suggested that, without special precautions, apart from reasonable care, pitch coke can be used in the cupola in place of foundry coke, either in full or in part substitution.

The authors investigated the equivalence of pitch coke and foundry coke in a series of tests made in a cupola, 40 in. internal diameter and 8 tons per hr. capacity. Details of the charges are given in Table I; these melts were analysed, the Shore hardness was determined, and the structure was examined on samples taken and prepared by a standard method. Results of hardness measurements and analyses, given in Table II, indicate that chill castings made with pitch coke are equivalent to those made with ordinary foundry coke; there is a slight increase in carbon content with pitch coke, although total carbon in the mixtures with pitch coke was lower than in test A with foundry coke alone. The hardness values were satisfactory, and no differences could be detected in the fine structures when etched with picric acid and the sections polished; sufficient ledeburite and cementite were observed in the products.

TABLE II.—*Composition and Hardness of Test Melts.*

	A.	B.*	C.*
	Per cent.	Per cent.	Per cent.
Analysis :			
C	3.46	3.76	3.64
Si	0.47	0.51	0.42
Mn	0.87	0.99	0.88
P	0.45	0.55	0.59
S	0.089	0.077	0.083
Average shore hardness at quenched edge	67	72	71

* Figures for all elements are averages of three melts in case of B and of two melts in case of C.

These results being successful, pitch coke was then substituted for foundry coke on a commercial scale; the advantages of this substitution are claimed to be the complete displacement of special irons and the ability to increase the proportion of broken castings in the mixture up to 70 per cent. The authors claim that ingot moulds of satisfactory durability can be made from a charge composed exclusively of broken castings when using pitch coke, with a consequent heavy saving in hematite. Several of these moulds were made and proved quite serviceable; 5-ton moulds had an average life of 125 casts, actually only 5 casts less than standard moulds. Charges of 100 per cent. cylinder and machine scrap were also melted down with pitch coke for making new cylinder and machine castings.

* It is presumed that the pitch coke referred to is retort carbon. The hardnesses reported seem somewhat low. We are unable to reconcile the heading "fluxes" with the word "Rest."—Editor.

High-Strength Cast Iron at Elevated Temperatures

Repeated load and short-time static load tests of unnotched and notched specimens cut from large plates of one heat of a commercial high-strength cast iron and tested at temperatures ranging from room temperature to 650 deg. C. are reported in a Paper by W. LEIGHTON COLLINS and J. O. SMITH, read at the recent Chicago A.S.T.M. meeting. A circumferential V-groove had practically no effect on the static ultimate strength and a small transverse hole had no significant effect on the endurance limit provided the net cross-section is used in computing stresses. The ratio of endurance limit to static tensile strength had an almost constant value of 0.44 for the entire range of temperature.

Standardisation of Coke Grades and Properties*

By W. L. BOON, M.I.Mech.E., Assoc.Inst.Gas E.†

The class and quality of coal used in the process of carbonisation exercise such material influence on the quality of coke produced that there would at first sight appear to be no prospect of approaching with any degree of success any problem of standardisation while restrictions on the choice of coals are imposed. Thus, considerations within the compass of this title are more essentially related to peacetime development; but even during the war much really useful work may be done towards standardisation which would be of considerable benefit to the gas industry for its post-war coke business. After the war the consumer of fuel may be expected, not unreasonably, to raise a more critical voice on the fuels he uses, and it must also be anticipated that the competitive position between solid fuels will be more severe and enable him to exercise once more the freedom of choice between fuels which has not been possible during the war. Hence, coke quality will assume even greater importance in post-war fuel than perhaps it did immediately before the war.

Quality of Coke

Whatever steps can be taken towards standardisation must have a beneficial effect upon quality. The judgment of quality rests finally with the consumer, whose assessment is based upon factors of practical operation and not upon analysis or the claims of producers for the excellence of their products. Quality of coke is, therefore, a relative term having a wide interpretation, and generally rather loosely applied in the gas industry.

TABLE I.—*Standard Sizes of Coke in Association's Area.*

Name.	Number.	Size.
1	2	3
Large or unbroken ...	1	Over a 1¾-in. square mesh, not sized to any upper limit.
2 in. by 3 in.... ...	1a	Within the limits of 1¾ in. to 3½ in. square mesh.
Broken	2	Within the limits of 1 in. to 2 in. square mesh.
Coke boiler nuts ...	3	Within the limits of ½ in. to 1½ in. square mesh.
Forge coke	4	Within the limits of ⅜ in. to ¾ in. square mesh.
Automatic stoker fuel or "screened breeze"	—	Is an unwashed fuel of approximately ¼ in. to ¾ in. from which the fines up to ⅛ in. have been removed.

Wherein the standard lies and upon what basis it is to be determined seems a fundamental question which must be answered before any problem of standardisation can be approached. If it is agreed that the consumer is the final arbiter, then the determination of quality is resolved into a consideration of the suitability of coke for the purposes for which the consumer uses it. If this basis of determination is accepted, then standards would require to be evolved for every class of coke utilisation, which broadly fall under six headings for all gas coke business: (i) Domestic hot-water supply; (ii) domestic open fires; (iii) central heating; (iv) steam-raising; (v) producer-gas plants; (vi) breeze. The development of standards to cover all these branches of utilisation presents no great difficulty, for much work has already been done in assessing the properties of coke required for each group.

Standardisation of Coke Sizes

Under present conditions it seems wise to accept the inevitable and to admit that the improvement of any of the above qualities by the choice of coal alone would not be practical. Hence, if we are to envisage progress of standardisation during the war our efforts must turn to other means. The factor which exerts the greatest influence in the successful use of most gas cokes is that of size, and, however the quality of the coke may be affected by other characteristics, the use of the correct size is essential if the consumer is to obtain the best results. The influence of size might in fact be well described by the blunt statement that "the worse the coke quality the more important becomes its size."

Within the last decade considerable attention has been focused on the question of standardising the sizes of coke produced for sale by the gas industry, and in the South of England particularly an important degree of size standardisation has been established. Table I shows the standard sizes of coke which are sold throughout the area of the London and Counties Coke Association, covering a total production approaching 4,000,000 tons per annum.

These sizes have now been in operation for the gas coke business in the Association's area for at least five years, and experience has indicated that all consumers' requirements of coke, whether for domestic or industrial use, have been adequately met by one or other of the above sizes. Prior to the introduction of these standards there were at least forty different sizes of coke produced and sold in gas coke markets in the South.

Advantages of Standardisation of Size

The benefits of size standardisation were soon evident to both consumer and producer. The consumer obtained for his particular purpose the fuel size which gave him the best results, and this has been consistently shown by the steady growth of coke business in the South which has taken place subsequent to the establishment of standard sizes.

This standardisation has not only brought about an orderly position in the coke markets of the South, but it has, at the same time, cut out old-fashioned nomenclature which was used in the industry; such terms as apples, chestnuts, potatoes, peas, etc., which had become established by ancient usage to classify size in the solid fuel industry were most conflicting, and certainly not compatible with modern marketing or the needs of a progressive industry. These terms are still used in other parts of the country, and should be deprecated in the coke industry as causing unnecessary confusion and as being thoroughly out of date. Whilst it is true to say that the great bulk of the gas coke produced in the South of England is now produced and sold under the new size standards, there is still a very large tonnage of furnace coke sold in the area in a wide variety of sizes, since coke-oven owners have not yet adopted the standards laid down for gas coke.

Furnace Coke

Some attempt has, however, had to be made to correlate all these sizes to the gas-coke standards in order to bring furnace coke within the price structure of this area, and Table II illustrates how this has been done. It is evident that the production of this multiplicity of sizes of furnace coke is totally unnecessary for its utilisation in the general markets in which gas coke is sold. Standards identical with those in operation for gas coke could equally well have been applied to furnace coke, because these standards are laid down within limits which within themselves permit an elasticity of size so as to allow for differences in coke characteristics. To illustrate this point, in the case of a small domestic hot-water boiler, in which No. 3 coke is normally used, if the coke is of low bulk density a larger proportion of the smaller sizes within the limit of, say, ½ in. to ¾ in., should be used, while if the coke has a high bulk density then a larger proportion of ¾ in. to 1¼ in. would give the best results.

The Future

During the years in which these standards have been in operation in the South of England, their results have been closely observed and there is ample evidence to prove their adequacy. There are no peculiarities from the point of view of gas coke utilisation in any part of the country which, in the author's view, would require any departure from these standards and, therefore, he would urge upon the industry for the good of its coke business that these standards might beneficially be adopted. There seems nothing to prevent consideration of this particular aspect of coke standardisation being undertaken during the war period. However the problem is examined, whether from the point of view of the utilisation of coke or from the aspect of its production, the benefits derived both by the consumer and the producer are positive, and from the commercial angle there is achieved at once a more orderly situation in the general marketing position.

TABLE II.—*Comparison of Furnace Coke and L.C.C.A. Sizes.*

Furnace coke size, in.	Equivalent L.C.C.A. size.
Over 3½, over 3, over 2¾, over 2½, 2¾ by 4, over 2, over 1½	These must all be taken as large or unbroken. No. 1
2 by 3½, 2 by 3, 2 by 2½, 1¾ by 2½, 1¾ by 3½, 1½ by 3, 1½ by 2½, 1½ by 3, 1¼ by 2½, 1¼ by 2¾	These must all be taken as No. 1a.
1½ by 2, 1 by 2, 1½ by 1¾, 1¼ by 2, 1¼ by 1¾, 1¼ by 1¾, 1¼ by 1½, 1 by 1½, 1 by 1¾, ⅞ by 2, ⅞ by 1½, ¾ by 1½, ¾ by 1¾, ⅝ by 1½	These must all be taken as broken No. 2
1 by 1½, ⅞ by 1¼, ¾ by 1¼, ¾ by 1, ⅝ by 1, ½ by 1, ⅝ by ¾, ½ by ¾	These must all be taken as coke boiler nuts No. 3
½ by ¾, ½ by ½, ⅜ by ½, ¼ by ½, ⅛ by ½.	These must all be taken as forge No. 4

The question of the quality of coke in relation to the uses to which it is put and the formulation of standards to control quality in all its aspects are matters which can follow when opportunity permits; but for the immediate future a great advance could be made by the adoption of standards for size. It might be argued that a multiplicity of sizes are necessary otherwise they would not have been produced. After a long experience of coke marketing, the author cannot agree with this contention; and the same principles would be true of the coal industry. One of the greatest burdens which the coal industry has to bear at the present time is the multiplicity of the sizes which have to be produced, and it has recently been agreed, after examination of this problem, that of the 300 odd sizes produced by the coal industry, only about 25 are necessary. This multiplicity has, in fact, grown up to meet the demands of all types and characters of people, having little knowledge of either utilisation or production, and upon examination of a particular demand it is often found that the size requested is wrong for the particular application.

(*Continued on page* 82.)

* From a Symposium entitled "The Gas Industry: 1941 and After," held in connection with the annual meeting of the Institution of Gas Engineers on June 11 in London.

† General Manager, London and Counties Coke Association.

The Week's News in Brief

Trade Talk

THE HEADQUARTERS of the Ministry of Labour and National Service are now at St. James's Square, London, S.W.1.

THE IRON CASTINGS SECTION of the Iron and Steel Control has moved from Ripley to the Clarendon Hotel, Leamington Spa (Tel. No.: Leamington Spa 2520).

A PRESENT OF A BRONZE plaque of the late Sir Robert Hadfield, F.R.S., made by Hadfields, Limited, of Sheffield, has been accepted by the Royal Society of Arts.

THE CANADIAN STEEL CONTROLLER has instructed that all orders on the books of pig-iron producers in Canada be cancelled in order to conserve supplies for essential war industries.

ALLIED IRONFOUNDERS, LIMITED, of the Ketley Sinclair Ironworks, Salop, announce a dividend of 5 per cent. to all workmen on their last year's earnings. In addition there will be an increased holiday grant.

THE MINISTRY OF LABOUR AND NATIONAL SERVICE, Whitehall, S.W.1, has issued two pamphlets on Training for War Work in the Engineering Industry, one of which deals with those aged 19 and over and the other below that age. They are available at most employment exchanges.

IN A STATEMENT by the Board of Trade on the progress of the concentration of industry, it is estimated that the numbers of workers released and to be released by schemes now under consideration total 110,000. The main factory space released or to be released by schemes is about 16,500,000 sq. ft.

INDUSTRIAL CONCERNS CAN NOW PURCHASE for their employees types of overalls which are not exempt from the Consumer Rationing Order, and other protective clothing and footwear, without coupons, if a certificate is obtained from one of H.M. Inspectors of Factories stating that the clothing is required for safety or health.

THE MINISTRY OF SUPPLY, IRON AND STEEL CONTROL, Ashorne Hill, near Leamington, Warwickshire, has just issued the third edition of the Iron and Steel Distribution Handbook, which brings the contents into line with Order No. 15, under which all iron products, except pig-iron, are incorporated in the Distribution of Steel Supplies Scheme as from September 1 next.

NEW POWERS in connection with undertakings the control of which has been taken over by the Government are contained in an Order in Council made by the King on July 18. The Order permits the removal and replacement of any person who, having managerial authority, "is acting or has acted in such a manner as to obstruct the authorised controller in the performance of his functions." Authority is also given for the acquisition at a fair price of all a company's shares and their transfer, with Treasury consent, to nominees.

THE LOCATION OF INDUSTRY (RESTRICTION) ORDER, 1941, which will come into operation immediately, provides that no person may, without a licence issued by the Board of Trade: (1) carry on at any factory or warehouse having an area of 3,000 or more feet super any trade or business not carried on there previously, or (2) carry on at other premises having an area of 3,000 or more feet super, whatever their previous use, a business of production or storage. Copies of the Order (S.R. & O., 1941, No. 1,100) will be obtainable at H.M. Stationery Office or through any bookseller on August 5.

MR. T. MEEHAN, Divisional Officer, speaking at a Branch Officers' Conference of the No. 2 (Northern) Division of the Iron and Steel Trades Confederation, said that, so far as the steel industry was concerned, it would be difficult for anyone to substantiate complaints of slackness and absenteeism. It would be safe to say that there was less prospect of that kind of trouble in the steel industry than in any in the country. One reason was that it was very largely a piecework industry. It was also a fact that, in many cases, skilled men in melting shops and mills were in receipt of less wages than before the war. In some mills there had been a certain amount of short time—but it was not because of absenteeism, but because managements, for one reason or another, had laid the mills off for varying periods. This point would be very largely taken care of when the industry came under the Essential Work Order, which was expected to be applied shortly. In regard to the operation of the Order, agreement had been reached with employers as to what would constitute a normal wage, particularly for tonnage and piecework men. Mr. Meehan said that arrangements had been made for the starting-up pay of women who might be, and were being, introduced to the industry.

Personal

MR. E. KANGLEY has been appointed industrial welfare officer to Thos. Firth & John Brown, Limited, Sheffield.

MR. J. G. WEIR has resigned his post as Director-General of Mechanical Equipment (design and development branch) at the Ministry of Supply. The resignation of his brother, Viscount Weir, formerly deputy chairman of the Ministry of Supply Council, is also announced.

MR. A. H. RAILING and MR. L. C. GAMAGE have been appointed general managers of the General Electric Company, Limited. Both are directors of the company. Mr. Railing has been for many years in charge of the engineering activities of the company. Mr. Gamage has been secretary of the company since 1920 and is also director in charge of export. He will continue to act as secretary.

Wills

STENTIFORD, W. H., a director of National Scrap Metals, Limited £11,316

BROWN, JAMES, of Greenock, director of Scott's Shipbuilding & Engineering Company, Limited £36,311

Obituary

MR. HENRY MAINWARING, brassfounder, of Chorlton-on-Medlock, Manchester, died on July 19 at Handforth, Cheshire, in his 61st year.

MR. ALEXANDER REID, a director of A. F. Craig & Company, Limited, Caledonia Engineering Works, Paisley, died recently. He was 49 years of age.

MR. H. J. MITCHELL, formerly president of Imperial Chemical Industries, Limited, died last week, aged 64. Mr. Mitchell was elected president of I.C.I. in succession to the late Marquess of Reading in 1936. He resigned on account of ill-health in 1938.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

R. Carson—Ironfounders, etc. £2,500. Mr. James Williamson, Rutherglen, Glasgow.

Bardine Tool Company—£1,000. J. H. Bufton, 51, Causeway Head Road, Dore, near Sheffield.

G. Desborough & Sons—Agricultural and constructional engineers, etc. £10,000. G. Desborough, 17, Tower Road, Burton-on-Trent; W. K. Desborough, and R. S. Griffin.

Contracts Open

Plymouth, August 13—Supply and erection of rotary boiler feed pump, for the Town Council. The City Electrical Engineer, Armada Street, Plymouth.

Loughborough, August 8 — Pumps directly coupled to, and including, electrical motors, 200 g.p.m., about 300 ft. boost; cast-iron pipes and specials, etc., for the Water Department. Mr. W. Granger, water engineer, Town Hall, Loughborough.

Ashford (Kent), August 9—Ejector station, overflow manhole and approx. 500 yds. of 7-in. cast-iron main and 100 yds. of 24-in. by 27-in. concrete tube sewer; electrically operated ejector plant, capacity 260 g.p.m., etc., for the Urban District Council. Mr. A. F. Webster, surveyor, 5, North Street, Ashford, Kent. (Fee £3 3s., returnable.)

Steel Foundry Workers Reserved at 18

Moulders and other workers in steel foundries, hitherto reserved at the age of 23 at stage C (18 at the earlier stage, B), are now entirely exempt from military service if over the age of 18. Coremakers (steel castings) are reserved at the age of 21. The changes, announced this week in a Ministry of Labour circular, reflect the importance which attaches to work in the steel foundry under wartime conditions.

The circular lists the following amendments to the Schedule of Reserved Occupations and Protected Work published last April, with consequential new entries where necessary. The age of reservation is the same at both stages (B and C). The age of reservation formerly applying at stage C is given in parentheses:—

Moulder, general hand (steel), 18 (23); cupola man, general furnace attendant (steel foundry), 18 (23); coremaker (steel castings), 21 (23); caster, pourer (steel), 18 (23); bench moulder (steel), 18 (23); floor moulder (steel), 18 (23); oddside moulder or plate pattern moulder (steel), 18 (23); plate moulder (steel), 18 (23); tub moulder (steel), 18 (23); machine moulder (steel), 23 (25); matrix maker, pattern moulder (steel), 18 (23); cylinder moulder (steel), 18 (23); roll moulder (steel), 18 (23); steel dresser, fettler, chipper, etc., 21 (23).

Tool room fitters, formerly reserved at the age of 18, are now reserved at 18/35, which means that their calling-up will be dependent on the nature of the work they are doing, judged from the standpoint of national interest, and the "key" nature of their job in a particular works.

Reports and Dividends

Boulton & Paul—No dividend on the ordinary shares (5%).

Brush Electrical Engineering—No dividend on the ordinary shares.

Herbert Morris—Half-year's dividend to July 31 on the 5% (free of tax up to 6s.) cumulative preference shares.

Greenwood & Batley—Profit to March 31 last, after tax, £112,783 (£83,390); final ordinary dividend of 10%, making 15% (13%).

Crossley Bros.—Net profit to April 30, £48,808 (£46,970); dividend on the deferred ordinary shares of 5% (same); forward, £34,815 (£32,885).

Vickers—Interim dividends of 2½% actual, less tax, on the preferred 5% stock, 2½% actual, less tax, on the 5% preference stock, and 2½% actual, free of tax up to 6s. in the £, on the cumulative preference stock.

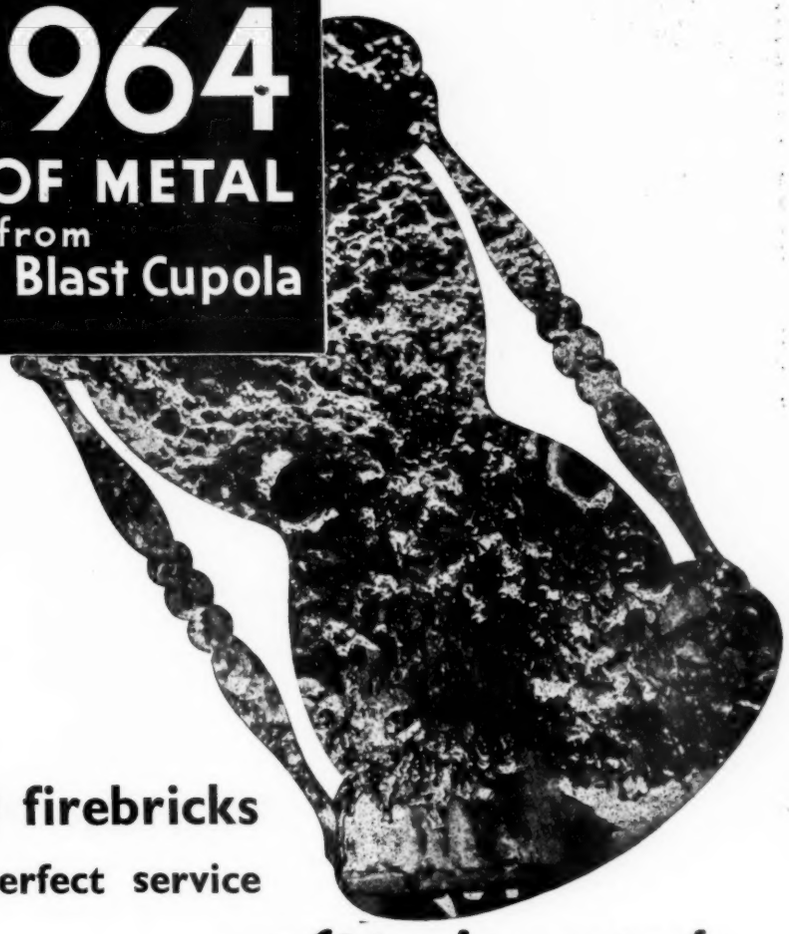
General Electric—Profit for the year to March 31, £1,722,643 (£1,892,994); depreciation, £444,598; war contingencies, £50,000; pension fund, £69,313; dividend on the 6½% "A" preference stock, £62,888; dividend on the 7½% "B" preference stock, £72,562; to income-tax reserve, £650,000; dividend of 10% (same) on the ordinary stock, £209,919; bonus of 7½% (10%), £157,439; carried forward, £812,791 (£811,931).

Standardisation of Coke Grades and Properties

(Continued from page 81.)

Briefly, therefore, there is no practical or useful reason for the wide range of fuel sizes which are still provided for the markets. On the other hand, a great deal of gas coke is not sized at all, which means that it cannot be sold effectively, and is not obtaining the revenue for the producer which it otherwise would do. The consumer of fuel is becoming more concerned with efficiency of utilisation in the fullest sense which can be applied to that term, and unscreened coke cannot be consumed efficiently. If coke is to be sold effectively, it must be screened to sizes to suit the consumers' requirements. These have been determined extensively and completely, and have been shown to be capable of satisfaction by a small number of size grades.

27,964 TONS OF METAL from Balanced Blast Cupola



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IN JULY 1934 Glenboig supplied a complete lining for a 45in. Balanced Blast Cupola to John Lang & Sons, Ltd., Lathe Manufacturers of Johnstone. The cupola, which has a continuously running spout, has already worked 1,569 days. The total tonnage of metal produced is 27,964. (The metal is used for high grade machine tools.)

The cupola has been operating five or six days and sometimes seven days per week. Not a single brick or split has been used during six years' service. This notable performance is in keeping with the Glenboig reputation for refractories of high consistently uniform quality.

This reputation is jealously guarded by the rigid application of a series of severe tests at every stage of manufacture, and remember—there is a Glenboig firebrick for every firebrick requirement.

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Raw Material Markets

Foundries producing light castings are able to acquire all the iron they care to accept; licences have to be procured from the Control before new purchases are made, but, generally, this procedure is promptly carried into effect, as the iron needed for the manufacture of light castings is high-phosphorus material produced from ores raised in this country. The authorities are, in fact, encouraging consumers in the light foundry trade to buy in excess of their immediate requirements, so that useful stocks may be established at consuming points: despite the fact that consumption in this industry is much below the level of peacetime standards, it is felt that the accumulation of supplies before deterioration of the weather tends to hold up deliveries is wise. Heavy engineers are less favourably situated, but essential works are getting all the low-phosphorus, hematite and refined irons they require, although many firms are using high-phosphorus iron more freely in their mixtures in order to eke out supplies of better grades made from imported ores.

Pig-Iron

MIDDLESBROUGH—No delay is experienced in the flow of foundry iron from furnaces in Northamptonshire and Derbyshire to consuming plants on the North-East Coast, and good stocks exist at many works. There is little change discernible in the position of the light-castings makers, who continue to operate below capacity, nor are there signs of any potential improvement, because the part which the trade can play in satisfying Government needs is comparatively meagre, while the normal outlets of the industry have been seriously disturbed by wartime restrictions. Nevertheless, the approach of the August holidays is not slowing down the demand for iron, as users are keen to buy ahead in order to avoid possible inconvenience later in the year, when the long haulage from the Midlands may present delays in deliveries.

Heavy engineers are still utilising as much high-phosphorus and refined irons as possible in their mixtures, but notwithstanding such measures of economy, demand for hematite is maintained at a level which the local hematite makers are unable to satisfy in full. Consequently, the Control are handing out a certain quantity of imported iron, but this material is reserved exclusively for high-priority work.

LANCASHIRE—Demand for foundry iron has tended to fall away in certain directions of late. The call from the light foundry trade has been at a low ebb for a long time past, many jobbing founders, too, are still operating at a reduced level, while the position of the textile-machinery industry has shown a quieter tendency recently, with the result that the demand for iron from this section has declined quite substantially. Consumers have been granted licences enabling them to cover themselves up to the end of November, and many users are taking advantage of the opportunity to get early delivery of their future needs. Speciality engineers remain briskly engaged on work for the various Government departments, and their position is likely to strengthen rather than deteriorate in the face of expansion in the war effort generally.

MIDLANDS—Conditions in the building trade remain somewhat lethargic, so that orders for domestic castings are within narrow compass. This factor, combined with the small contribution of the light-castings industry to contracts for war materials, has greatly reduced the output of works compared with peacetime standards, and, consequently, much less iron is being consumed. Despite the decline of light-castings manufacture, furnaces producing high-phosphorus iron are quite well engaged, as there is a moderate tonnage being called for by heavy foundries, which are using this iron where practicable as a substitute for the better qualities. Makers of heavy castings, generally speaking, have as much work on hand as they can accommodate, and are in the market for all the low-phosphorus and hematite irons they can get. It is not possible to obtain maximum deliveries, but urgent needs are promptly relieved, it being necessary at times to distribute imported iron.

SCOTLAND—Works in this area have again resumed production following a short holiday, and in the heavy engineering section, particularly, full order-books are the rule, as Government specifications are ample to ensure maximum outputs being absorbed. Conditions are much less favourable in the Falkirk and district light-castings trade, where the position varies from works to works, but only a few concerns are really well placed.

Coke

It was stated in our last issue that the minimum quotation for Durham best foundry coke had been raised by 1s. 3d. per ton, but this increase should have been applied to Welsh coke only. Although it is expected that the price of Durham fuel will also be increased in the near future, no official intimation of any change had been received at the time of going to press, so that the current quotation is still 62s. 9d. per ton, delivered to stations in the Birmingham and Black Country district. Satisfactory supplies are being sent out by the ovens, and it has been possible for a number of users to buy tonnages over and above their early requirements.

Steel

It has been ascertained from official quarters that the reports of the closing down of certain steelworks which have circulated freely of late were actually incorrect in so far as they were based upon a misunderstanding of the true position. The fact is that the authorities are determined to relate even more closely than hitherto the production of the various classes of steel to the needs of the war machine; with this aim in view, a committee has been set up to inquire into conditions in the tinplate trade, and sheet makers have been requested to co-operate in a joint scheme for a reduction of production. This to a large extent explains certain changed conditions in the steel trade during recent weeks, while there also has to be considered the fact that the Control have lately been holding up forward business to permit certain producers to catch up on their commitments and to allow excessive stocks to be reduced.

Scrap

Deliveries of most descriptions of scrap iron and steel are satisfactory, and any delay is now largely confined to the heavier grades of scrap, which are in constant demand, especially by the steel plants. Ironfoundries, on the whole, are able to procure adequate supplies for current needs, and some have reserve stocks at their command. Consumption of scrap in the foundry trade is at a high level and tends to expand.

Metals

COPPER—Very small tonnages of copper are being distributed outside the range of essential requirements and, while priority consumers are receiving full deliveries, other users are unlikely to be permitted to buy larger quantities than they have purchased in past months. It is satisfactory that there is an ample supply of metal for the war machine, in which copper is an important factor. Home outputs of extruded copper and brass products are fully taxed, and it is hoped that deliveries from the United States will be on a freer scale shortly. The New York Commodity Exchange has discontinued trading in copper futures.

TIN—It has long been obvious that Japan has been endeavouring to accumulate war materials on a vast scale. Although the extent of her stocks has been concealed fairly successfully, it is not thought that Japan's position is particularly secure, and her occupation of French Indo-China territory will not bring her any great prizes, while the counter action of Britain and America amounts to a virtual commercial blockade. Japan will now be denied the privilege of purchasing zinc concentrates from Australia and Burma, lead from Australia, and iron ore, bauxite and manganese from the Japanese-owned mines in Malaya, together with many other commodities. The tin market in London has withstood well the unsettled conditions, which might have been expected to have upset the steady trend of prices. It is believed in London that a quantity of Straits tin has been reserved for Russia. The U.S.S.R. is thought to be anxious to secure early shipment. Buying interest in the United States has been somewhat brisker, particularly in near arrivals.

Tin prices on the London Metal Exchange during the past week have been as follow:—

Cash—Thursday, £259 15s. to £260 5s.; Friday, £261 to £261 5s.; Monday, £261 to £261 10s.; Tuesday, £258 10s. to £259; Wednesday, £257 to £257 5s.

Three Months—Thursday, £262 15s. to £263; Friday, £263 10s. to £263 15s.; Monday, £262 15s. to £263; Tuesday, £260 10s. to £260 15s.; Wednesday, £259 15s. to £260.

SPELTER—Operations at many galvanising plants in the United Kingdom are rather quieter, so that consumption of g.o.b. spelter is correspondingly reduced. A large proportion of the Empire output of g.o.b. metal is gained by the debasing of electrolytic zinc, so that the less active conditions in the galvanising industry may eventually lead to freer supplies of metal in other directions. Brassmakers and diecasters are unable to utilise g.o.b. zinc, and their demands, which tend further to expand, have attained an exceptionally high level.

LEAD—"Non-essential" users who may be said to be working on useful civilian orders are experiencing little difficulty in obtaining supplies of lead, while a certain amount of export business is also sanctioned from time to time. Otherwise licences to buy lead are granted only to works employed on Government contracts, chief among which are cable and battery manufacturers.

Patent Specifications Accepted

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

533,851 TENNANT, W. J. (Armour & Company). Production of sand cores.

533,873 THORNTON, A. A. (Sheffield Steel Corporation). Grinding-elements for use in ball mills, and method of making such elements.

533,886 DENNEEN, F. S., and DUNN, W. C. Equipment for heat-treatment of articles, particularly for the surface hardening of crankshafts and the like.

533,910 TITANIUM ALLOY MANUFACTURING COMPANY. Insulating-refractories, and methods of making same.

533,911 TRIGGS, W. W. (Emulsions Process Corporation). Method of making steel.

533,964 TYCE, G. C., MURRAY, J. J. L., and IMPERIAL CHEMICAL INDUSTRIES, LIMITED. Portable abrading-machines.

533,975 ELECTRO METALLURGICAL COMPANY. Process for decarburising metals and alloys.

533,977 BRITISH THOMSON-HOUSTON COMPANY, LIMITED (Ferguson, J.). Electric furnaces.

533,984 ELVY, C. Pins for locating and holding in position metal plates or the like during riveting or other operations.

533,994 SOC. ANON. USINES STANDARD (STANDARD DRUM & BARREL COMPANY). Sheet-metal drums.

534,010 BLISS COMPANY, E. W. Method of testing cans for air-tightness.

534,012 BRAYSHAW FURNACES & TOOLS, LIMITED. BRAYSHAW, S. N., NEWMAN, F. C., and RUSHTON, F. Furnaces or combustion chambers for the heat-treatment of metals and alloys.

534,029 TAUBER, E. Arrangement for preventing the formation of organic deposits on iron hulls.

534,035 STANTON IRONWORKS COMPANY, LIMITED, WILSON, P. H., and DAWSON, S. E. Casting of metals.

534,046 PERCIVAL, S. (Air Reduction Company, Inc.). Welding or brazing processes.

534,048 MALLORY METALLURGICAL PRODUCTS, LIMITED (Mallory & Company, Inc., P. R.). Refractory metal compositions and their production.